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## DESTRUCTION OF THE CROTON DAM, WITH PLAN AND SECTIONS (See page 233.)

BY W. R. CASEY, CIVIL ENGINEER.

*Bailey vs. the Corporation of New York.*—This was an action to recover damages, caused by the giving way of the Croton dam on the 8th January, 1841, on the ground that the dam was negligently and unskilfully planned and constructed. The great points of objection were, that the waterway was insufficient to pass floods such as those of 1837 and 1839, and that the structure itself was, for various reasons, unsafe and injudicious.

One proof of the want of waterway was as follows: two hours before the dam gave way the water was up to the coping of the parapet wall. A messenger was then despatched to warn the people below that the dam could not stand much longer; yet, half an hour before it burst away, the water in Bailey's mill pond, two miles below, was six inches lower than in previous floods. So that however great the flood may have been *after* the dam gave way, at that moment it had not reached ordinary high water mark, as in 1837 and 1839.

This was confirmed by the following surveys and calculations. No dams remaining across the Croton river, the dams on five of the six main tributaries were measured, and the sixth, on which there was no dam, was approximated. These dams vary in length from 50 to 107 feet, with a depth above the lip in time of freshets, of from 3 to 6 feet 10 inches. These streams are —commencing near the dam—the Kisco, Muscoot, Cross river, Titicus, East and West Branches of Croton.(1) The rise was taken from 50 to 100 feet above the overfalls, not only to avoid the depression which takes place for some distance above the lip, but, because in this case, it was the height to which the water would rise at the head of the masonry, about 90 feet above the lip, which was alone important. As soon as it reached the coping, the destruction of the dam was of course certain.

The height of the parapet wall between the waterway and the embank-

(1.) This calculation makes no allowance for the four or five times greater velocity of the water in the shallow mill ponds of the tributaries, as compared with the gentle flow through the Croton lake, 4 miles long and 30 to 40 feet deep, or for the greater ease with which the water reaches the overfall of these dams, nor does it take into account three considerable brooks and eight or ten minor streams —insignificant in droughts, but torrents during a freshet.

ment is 12 feet above the lip, and the city engineers claimed an efficient waterway of 85 feet in width and 12 feet in depth! They also claimed as efficient waterway, after the water has risen 8 feet on the lip, the breadth of the platform leading into the culvert house! The writer considered 80 feet as very liberal, and doubts whether many engineers could be found who would consider this dam as equivalent to one with 70 feet lip, at right angles to the current, and with skilfully projected or even decent approaches so as to make the dischage something near a maximum. The area claimed above, whether as regards depth or breadth, requires no refutation beyond its mere statement, it being hard to say, whether narrowing the waterway of a dam 40 feet high, so as to have 12 feet on the lip in freshets, and the water flush with the upper surface of the parapet wall, shows less acquaintance with practical engineering, than does the claiming, as efficient waterway, the width of the platform, below the culvert house, prove ignorance of the principles of hydraulics.

Now the measures of these various streams for 1839, when reduced to a lip of 80 feet, gave a depth of 12·8 feet; to 85 feet, 12·6 feet; to 75 feet, 13·4 feet. It was objected to this mode of calculation that the tributaries do not reach their maximum at the same moment—an objection of course foreseen and to which the equalizing(2) effect of the 400 acres of the Croton lake and the circumstances detailed in Note 1 were considered a fair offset. But the object of course was to obtain the relative not the absolute rise, though it will be seen, that even this latter was very closely approximated. With reference to the former the objection vanishes.

This mode was adopted in 1841, and the flood of 1843 gave a good opportunity of testing its accuracy. The measurements of the flood of 1843 gave a depth of 13·4 feet on 80 feet=12·9 feet on 85 feet=6 feet on 269 feet. The *actual* height was given as about 6 feet on the new dam 251 feet long, or adding the discharge through the culvert and aqueduct,=a lip of 258. From observations made the morning after the flood, the writer has much confidence in stating the depth at 6·33 feet. The flood of 1841 was calculated in the same manner, and gave a depth of 14·5 feet on 85 feet lip. So the floods of 1839, 1841 and 1843 are to each other as 1, 1·16, 1·03, according to evidence given on the trial. But, taking into consideration some modifying circumstances, which would have occupied too much time in a court of justice, the floods of 1839, 1841 and 1843 are to each other as 1·04, 1·14, 1·00. In 1839 the dam on Cross river gave way during the freshet, the

(2.) To prove this, take Hoghill brook, one of those omitted in the calculation. This stream has risen 4 feet on an overfall of 32 feet - about 1,400 c. feet per second, sufficient to raise the 400 acres of the Croton lake 3·5 inches in one hour; but, during that hour, the discharge over 85 feet, with a depth of 3·5 inches, would not lower the lake one forth of an inch. Hence, several hours would elapse before the minor streams would raise the lake high enough to make their escape over the Croton dam as fast as they come in above. But it is proverbial on the Croton, that, when the small streams fall, the large ones begin to rise, and in the natural state of the river the former would be in or pretty near the Hudson, only 8 miles distant, instead of being, as now, pent up in the Croton lake until the main tributaries come down and pour their floods over the Croton dam simultaneously with the waters of the minor streams. Again, although in the freshet of 1843 the tributaries fell more rapidly than ever before observed, the water on the Croton dam rose to and receded from its maximum very slowly, obviously on account of the equalizing power of the Croton lake.

subsequent rise was not taken into account in the evidence, by which omission the flood of 1839 appeared less than that of 1843.

Again, it was proved that the flood of 1837 rose from 15 to 18 inches above the brick floor of Bailey's rolling mill, and, 2 or 3 square feet of this being fortunately left, the writer took the level of this fragment of the wreck, and found it 20 inches below extreme high water mark of 1843. The resident engineer testified that the flood of 1839 was only 7 inches higher than that of 1837, so that the freshets of 1839 and 1843 were shown to be nearly equal by two independent measurements: 1, by measurement of the tributaries; 2, by their near equality with the flood of 1837, and consequently with each other. Lastly, it has been stated, that half an hour before the dam gave way, the water at Bailey's dam was 6 inches lower than in 1839—it was further proved by all witnesses living on the Croton, at or near the site of the dam, that the flood of 1839 rather exceeded that of 1841, by observations taken as soon as the "lake" had run out and the river had resumed its natural appearance.(3) So that in fact, the defendants were indebted to the writer—the plaintiff's engineer—for the only plausible reason that the flood of 1841 might have slightly exceeded that of 1839. An examination into the peculiarities of the floods of 1839, 1841 and 1843 will satisfactorily explain all. In 1839 the freshet was general, all the streams being high—in 1841, the Muscoot and the two branches of the Croton were very high—in 1843, the minor streams and the Cross river were higher than ever since the great July flood, 46 years ago. Now, the east and west branches having their sources at a great distance, and draining a greater area than all the other streams together, do not discharge their floods into the lake till some hours after these latter have been falling, which they do with great rapidity. Hence the entire Croton may have been higher at the point of observation, two miles above the dam, in 1839 than in 1841, though the total discharge into the Hudson may have been much greater in 1841 than 1839. It is the highest rise during the flood which is alone important in this investigation.

Another view may be taken of the requisite waterway to pass any floods which can be expected. The writer was examining the streams of the Croton for the third time in March last, and from personal observation of the storm, has no hesitation in stating, that, considering the rain only lasted 12 hours, that the snow was nearly all in drifts and a large portion of it left, that 12 hours after the rain ceased, the wind chopped round to north-west, causing the tributaries to fall more rapidly than ever before known, and actually preventing the two main branches from reaching their ordinary flood mark—combining all these circumstances, he can only view the flood of 1843 as an ordinary high freshet, such as has occurred four times during the last seven years. Had the rain lasted two hours longer, and had the weather

(3.) It is well known that the Croton attains its maximum about 12 hours after the rain ceases, which would give the highest water on the 8th January, 1841, about 10 or 11 A. M., when it was proved, beyond all doubt, that it did not quite equal the flood of 1839, at a point two miles above the dam, and below all the main tributaries.

cleared off warm, the flood of 1843 must have stood 6 feet on the very edge of the fall and between 7 and 8 feet at the upper end of the culvert house. Had the snow of 1836 gone off as rapidly as in 1839, the flood must have been almost twice as great as that of 1843. Such occurrences are anything but impossible, and common prudence would lead us to anticipate them. Yet every engineer will see that the floods of 1837, 1839 and 1843 were far more than sufficient to have swept away the old dam, and if we allow one half for any flood which can be expected, we shall have a waterway of about 400 feet, supposing the water in the pond not to rise more than 6 feet above the lip. To withstand this column of water will require much more substantial work than is, or rather was, to be found at the foot of either the old or the new dam.

The water commissioners say in the first part of their report, 11th January, 1841, (Doc. 39, p. 513,)—"The width of the sheet of water flowing over the dam is 90 feet, and it is supposed in time of a freshet, will be from 4 to 6 feet deep; it has already, in the last autumn, been equal to 3 feet."

In the same report, after the news of the flood had reached them, they say (p. 534,) "We have stated above, that the calculation was, that the water might rise from 4 to 6 feet above the overfall dam, but instead of this, it rose to about 15, and for this rise the dam was not calculated; the earthen embankment gave no protection against such a height of water; and the overfall was not of a capacity, although 90 feet in length, to discharge the water which the flood brought down. * * It is obvious that greater provision must be made to allow this stream to pass, in its natural channel, in time of freshets."

Here it will be seen that nearly two years after the flood of 1839, the commissioners—of course by authority of their engineers—state that the Croton will rise from 4 to 6 feet on their dam, when the Muscoot alone in 1839 rose 4 feet on a lip of 82 feet; the Titicus 4½ feet on 73, and the two branches of Croton united, above 6 feet on 100. In March last the Cross river rose 5 feet on 107 feet, which, taking into account the greater velocity of approach, is more than the entire Croton was ever to discharge, according to the views of the commissioners and their engineers.

The defendants asserted, that the flood of 1841 was not only greater than any previous known flood, but so much greater that it could not possibly have been foreseen. That they had a waterway capable of passing 50 per ct. more water than passed in the flood of 1839. The choice lay between exaggerating the flood of 1841 or underrating that of 1839. The latter course was adopted, thus: the freshet of 1839 occurring during the construction of the dam filled an area of 1028 square feet, including its own additions to the prepared waterway; the flood of 1843 filled an area of 1472 feet at Tompkins' bridge one-fourth mile below, and, *assuming* the velocities to be equal, the flood of 1839 would rise 7 feet 4 inches on a lip of 85 feet, the flood of 1843 would rise 10·64 for 85 feet—the depth being in both

cases taken at the edge of the fall. The flood of 1841 was taken as equal to 13 feet on 85, though nothing can be more uncertain than its depth *on* the lip for some time before the dam gave way. It will be observed that the flood of 1843 was necessary to the assumption, the whole statement having been prepared for the trial.

Another calculation, the surveys for which were made a few weeks before the trial, was presented, based on the *assumption* that the rise in floods was proportional to the area drained—contour of ground, clearing of land, and aspect going for nothing—and that all the tributaries were equally affected by the same flood. Unfortunately for this latter theory, the lower tributaries, draining one-third less land, discharged in 1843 one-third more water than the upper tributaries, owing to local causes, and sudden change of weather.

But the most extraordinary circumstance of this defence was that no measurement whatever of the absolute quantity of water passing in freshets was taken previous to, or during the construction of the dam. The area of the flood of 1839 was known, but the velocity was not taken. Now there was Bailey's dam within half an hour's walk of the Croton dam, over which had passed the floods of 1837 and 1839, and where proof of the most overwhelming kind would have been furnished any day, that ordinary prudence required a waterway quite as large as that of the new dam—250 feet. It did not appear that any marks had been established, or anything whatever done to determine the maximum flow of the Croton, before the completion of the dam. The freshet of 1843 ran over the floor of the bridge below the new dam, so that even up to 1843 the flow of the Croton in high floods was an enigma to the chief engineer, who, it appeared on the trial, had paid peculiar attention to the work.

In judging of the construction of the dam, it must be borne in mind that the engineer had "carte blanche" as to location, plan, dimensions, material, and —last though not least—time, to say nothing of competent assistants—in short every advantage which could possibly be desired. Justice to him requires us to consider this as his "beau ideal" of a permanent dam, for the most important of all purposes for which any structure can be designed, in which his principal assistant coincided, testifying that he considered it to be a structure of "unexampled strength." The resident engineer gave no opinion on the subject.

The writer's objections were: that the approach was bad, that the entrance should be somewhat in the style of that of a lock or culvert, instead of converging up stream, that the angular wingwall presented the junction of earth and vertical masonry to the current, instead of being carried around 40 feet into the solid bank, thus aiding the discharge as well as increasing the stability; that the greater part of this wingwall rested on a crib of concrete, and on account of unequal settling, was carried up without any bond, "rich grout" being poured into the seam whenever any settling took place, and that

a very small opening of this joint would render the loss of the dam inevitable. That the loss of the apron endangered the dam by causing the undermining of the protection wall at its junction with the apron and masonry, which would be followed by the sand of the embankment till the latter became too weak to stand against the pressure from above.

Mr. Clowes, an experienced engineer, objected to the embankment "in toto," that a wall of hydraulic masonry should have been carried across the valley; that the dam should have been arranged with flash-boards for summer, so as to keep the permanent lip as low as possible, every foot in height being an object with such a mass of water; that, over a smaller river than the Croton, he had, from prudential considerations—the result of 30 years observation—built a dam with a tumble or lip of 400 feet with less than one-third the fall of the Croton dam; that it was injudicious to make the reservoir *in* the river, when there were so many opportunities of making more secure ones in vallies crossed between Sing Sing and the Harlem river.

It was urged on the defence that, though the entrance was narrower it was much deeper than at the lip, and gave a much greater section, hence the width was unimportant; in other words, it might have been worse had the depth as well as the breadth been reduced. The wingwall was not to add any strength to the dam, but merely to keep the embankment from filling the culvert. 17 feet below the lip, hence a slight opening of the seam—even if it did take place—would be harmless. That to carry the wingwall 40 feet into the bank would be an unheard of precaution, and that the pressure of the earth against the masonry with one or two little projections running 8 or 10 feet into the embankment was abundantly sufficient. The only remark bearing on the apron was, that it was admitted to be quite inadequate to withstand the action of 10 feet (*) water on the lip, though an efficient waterway of 12 feet had been previously claimed by the very same engineers —the only engineers giving evidence on the part of the defendants. Mr. Clowes had objected also to the quality of the earth forming the embankment —principally sand—with a tendency to quicksand; the engineers of the city considering it a good material for the purpose, being composed of sand, gravel and loam. The writer observed also that the thickness of the banks of the enlarged part of the Erie canal was 7 times the depth, about the same proportion as obtained here, *except* at the wingwall, where the embankment offered the least resistance though the pressure was the greatest.

Numerous other subjects came up, as the value of the cribwork in the embankment, the almost universality of the custom of making the lip much wider than the stream in its natural state in place of as here, narrower, but

(4.) The apron of the new dam was torn out by the freshet of March last, though the face of the waterway is curved so that the water leaves the foot of the masonry in a horizontal direction. Still the apron of crib work—unquestionably superior to that of the old dam—gave way the first flood with four and a half feet water on the lip; the water excavated a large hole at the foot of the masonry and it will require great exertions, a large expenditure, and good luck, as regards weather, to render the dam reasonably secure against a great flood next spring. Its fate, with a great summer flood—such as has been known in the Croton— would be scarcely doubtful, and, viewed even in the most favorable light, the condition of the dam is, at this moment, most unsatisfactory.

above all, the propriety of carrying a vertical stratum impervious to water entirely across the valley, as for instance a wall of masonry founded on solid rock or secured by two or three rows of well-jointed piling, etc., in short, that at least all the precautions taken on works of far less importance should have been found here.

Appearances after the flood were described to have been as follows: embankment and protection wall gone, masonry of dam proper, generally uninjured, except a few of the lower courses of the face of the dam which were carried away. The first course was stepped into the solid rock, and this being unable to withstand the action of the water, the masonry of course followed and many pieces were carried far down the river. The wingwall from the joint northward was gone, also the crib of concrete —one piece, more than 20 tons in weight, having been carried several hundred feet down the river—also a large crib sunk across the natural channel, near the head of the masonry, used as a cofferdam during the construction of the work. The filling of the old channel was taken out down to, or below the original bed and the foundations of the remaining masonry, where not of solid rock, were torn from under, so that a bar could be in some places run from 4 to 6 feet under the abutment wall. Yet 60 feet north of the masonry, and on the same level, the sand and gravel remained undisturbed, showing an almost irresistible force acting along the base of the abutment, yet confined to so narrow a space as to have been harmless at the trifling distance of 50 or 60 feet north of it. Apron entirely gone and 20 feet of water in its place.

This description agreed well with the appearance of the dam in July, 1841, when visited by the writer. The water was then very low and the powerful action of the flood near the foot of the masonry was so clearly indicated, that he had no hesitation in concluding, that such effects could have been produced by undermining only.

The destruction of the dam on the 8th was considered a matter of course in that part of the country, and would have been honored with a large audience had it taken place by daylight. As it was, it was seen only by those at work on the embankment, and by one man on the south side of the river. The former, witnesses for the defendants, were one of the contractors, (Crandall,) a superintendant of masonry, (Adamson,) and a laborer. They testified that the water forced it way between the frozen and soft earth, that it broke out about 100 feet north of the masonry, and about 8 feet below the top of the embankment, running over the protection wall and widening to a channel of 150 feet, but leaving about 40 feet of the embankment and protection wall standing next the masonry; that this continued for about an hour, at the end of which time the water was still running over the lip of the dam proper. The witness for the plaintiff, (Green,) a very intelligent mechanic, who stood on the south bank, swore, that just before the dam gave way he observed a whirlpool immediately above the wingwall, suddenly the

water receded from the bank and burst through the foot of the embankment at the masonry, the protection wall above, falling, as it were, up stream. The hill on which he stood trembled with the shock, and the noise was heard for miles in all directions.

A son of one of the contractors, (Brayton,) on the part of the plaintiff, testified that two hours before the dam gave way, the earth behind the wing-wall was very soft, that water was to be seen on the lower side of the wall in violent agitation, that the men on the dam were trying to fill the hole up, and that a load of earth was dumped in. This was admitted by Crandall, who ascribed the softness of the earth to the rain.

It will be observed that Green swore that the embankment next the masonry went first—Crandall and Adamson that, an hour after the water broke through, it was the only portion left. There is no reconciling these statements. Whether it be physically possible that an embankment of sand, supported by a dry wall, should stand as a dam 40 feet high, for one hour with 8 to 10 feet of water rushing over it and that this same mass of water, aided by 400 acres of ice, should fall during that time from that height without disturbing the sand and gravel on which it fell, are questions to which but one answer can be given. But, independently of this, it was contended that the appearances near the dam—the rapid falling of the lake two miles above the dam, 6 or 8 feet in 1 or 2 minutes—the noise distinctly heard 6 miles off—the marks of the ice on trees 30 feet above the level of the river—the rise of more than 20 feet at Bailey's wire works, though the valley is a quarter of a mile wide and two miles below the dam, sweeping away houses, barns, mills and even heavy rolling machinery in its mad career, showed conclusively that the dam gave way at once, instead of being gradually washed down.

The grand argument on the part of the defence was, however, the high standing of Mr. John B. Jervis, an engineer at the head of his profession in this country, the greatest country for public works, in short the "greatest practical engineer" of the age, just about to retire on his laurels, which would be withered by a verdict for the plaintiffs. Still *if* they believed negligence to be proved, they must find for the plaintiffs, "*and let the country bleed.*"

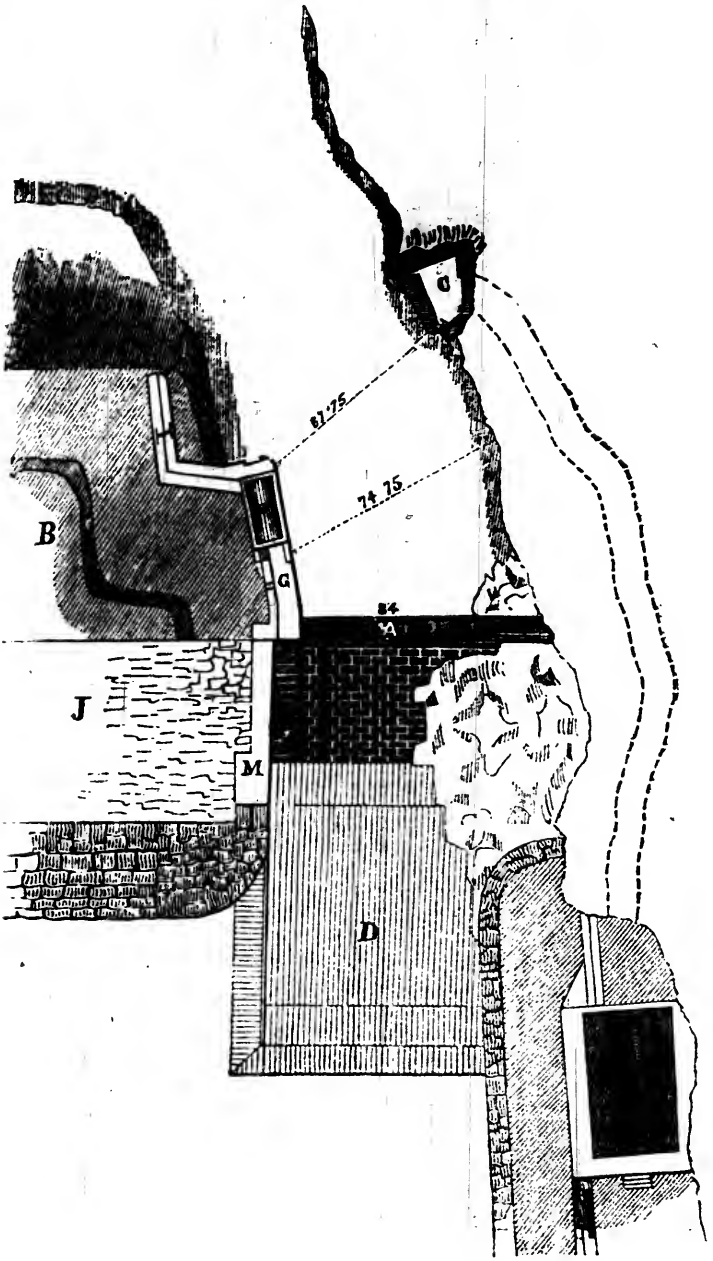
The cool, contemptuous style of the following remarks of the commissioners—one of them an engineer of high standing and great experience—says more than the most violent invective could do; the common sense view in the last passage, as obvious as it is irresistible, would of itself have justified the verdict rendered for the plaintiffs. (The italics are the writer's.)

Doc. 17, Report of the Water Commissioners, 12th July, 1841, p. 87

"The construction of the dam *now* building, will, according to the estimates, amount to about one hundred and twenty-seven thousand dollars; but it must be recollected that *this* dam will be a *mason work* dam, laid in hydraulic cement, in the place of the *mere* earthen filling in, with a *dry* protection wall laid with *rough* stone, so that the dam when *now* finished will be an *entirely* different structure from *that* part of the dam carried away, and will *correspond* in strength and durability with the *rest* of the work, certainly much more so than the dam as *formerly* constructed; *and as the dam creates the supply, the importance of its strength and durability, in the original construction, is very obvious.*"

*New York, July*, 1843.

Note. Of the numerous works on hydraulics consulted by the writer, no one gave so good a view of this branch of the science as Mr. Roebling's essay, published in this Journal, December, 1838.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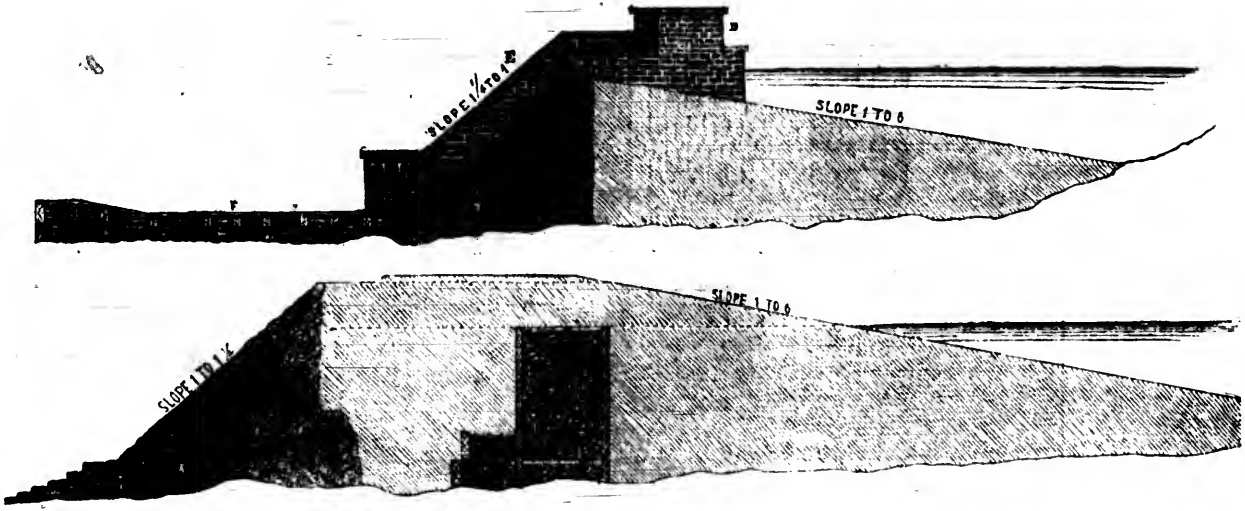


REFERENCES TO PLAN.

A, Lip,
B, Embankment,
C, Mouth of tunnel,
D, Apron,
E, Gate house,
F, Culvert house,
G, Abutment platform,
H, Abutment parapet,
I, Wing wall,
J, Protection wall,
K, Culvert.

REFERENCE TO SECTIONS.

D, Culvert house,
E, Abutment,
F, Apron,

Scale 60 feet, to 1 inch. Embankment 250 feet long.

RAILROADS IN GERMANY.

The year's result of the German railroads at present in activity has been published, and shows an increase of nearly two millions of travellers in 1842 as compared with 1841. The following table will show the number of passengers and the amount, (in English money,) received for passengers and goods during the month of December, and during the whole of the year 1842.

| Names of Railroads. | During December, 1842 | | During the whole of 1842 | |
|---|---|---|---|---|
| | Number of passengers. | Money received. | Number of passengers. | Money received. |
| Linz-Budweis, | None. | £1,566 | 14,274 | £23,992 |
| Linz-Gmunden, | 5,556 | 1,258 | 121,155 | 20,055 |
| Leipzig-Altenburg, | 8,173 | 1,072 | 43,622 | 5,266 |
| Munich-Augsburg, | 9,229 | 1,563 | 213,647 | 26,865 |
| Hamburg Bergedorf, | 9,315 | 242 | 153,648 | 5,277 |
| Berlin-Stettin. | 12,135 | | 70,880 | |
| Berlin-Frankfort, | 13,278 | 2,186 | 35,274 | 7,385 |
| Breslau-Oppeln, | 14,236 | 932 | 139,099 | 8,633 |
| Manheim-Heidelberg, | 16,506 | 522 | 307,692 | 9,696 |
| Cologne-Aix la Chapelle, | 17,760 | 2,439 | 317,776 | 39,914 |
| Dusseldorf-Elberfeld, | 19,113 | 1,153 | 384,946 | |
| Brunswick-Harzburg, | 20,700 | 2,329 | 289,454 | 14,893 |
| Berlin-Anhalt, | 20,925 | 5,873 | 318,659 | 79,577 |
| Vienna-Stockerau, | 20,826 | 1,076 | 321,490 | 14,894 |
| Vienna-Brunn-Olmutz, | 21,638 | 9,416 | 297,505 | 110,617 |
| Magdeburg-Leipzig,* | | | | |
| Leipzig-Dresden, | 24,932 | 7,465 | 377,380 | 98,579 |
| Berlin-Potsdam, | 30,505 | 1,565 | 500,906 | 23,692 |
| Mentz-Frankfort, | 32,811 | 1,487 | 809,012 | 37,795 |
| Nuremburg-Furth, | 33,874 | 402 | 450,635 | 5,271 |
| Vienna-Raab, | 36,535 | 3,795 | 1,151,393 | 71,641 |

The total number of passengers during the month of December, (without including Magdeburg and Leipzig,) was 368,049; the number in the corresponding month of 1841, was 280,864. During the whole year of 1842, the number of passengers was 6,829,002, whereas in 1841, the number was 5,071,342; so that, on the whole year, there appears an increase of 1,757,660. In the returns of several of the lines the amount received is not specified, owing to their not having made up their accounts for the last quarter at the time the general statement was made up. Approximate calculations have in the mean time been made, according to which the whole number of travellers, along all the lines, has been estimated at 6,870,000, and the amount received 7,000,000 Rhenish florins, or about £583,333; a sum perhaps less than was anticipated by the original estimates of the different companies, but which must still be looked on as large, when the circumstance is taken into account that the majority of the twenty-one railroads enumerated in the above table are still incomplete, or are only portions of a more extensive system, the real traffic of which will not be known until the whole system has been brought into activity. Even those lines which are complete, such as the lines that connect Berlin and Dresden, or Vienna and Olmutz, will probably become much more productive to their proprietors when the other lines now in construction shall have covered all Germany with a net of railroads.

The Linz-Budweis railroad conveys no passengers during the winter months, owing to the accumulation of snow in the mountains, and the con-

* Had made no return at the end of January.

sequent impossibility of making the trips with any degree of regularity. Indeed, upon all the German railroads, it will be seen the number of travellers was small in December, compared to the monthly average of the year.

The Leipzig-Altenburg line is only the commencement of one which is to connect the chief cities of Saxony with those of Bavaria. The road was partially opened to Altenburg on the 19th of September, and will in a few months be further opened to Crimmitzschau. The Bavarian government seems determined that that part of the railroad which will traverse Bavarian ground shall be constructed with the least possible delay. The railroad is to enter the Bavarian territory at Hof, whence it is to pass through Augsburg and Nuremberg, and run on to the southern frontier at Lindau; thus traversing the entire kingdom from north to south, a distance of about one hundred and fifty leagues. The bill for the construction of this railroad has been submitted to the Bavarian Chambers. The expenses of the construction are to be covered by a loan.

The Munich-Augsburg company have declared a dividend for the year, on their shares, of three per cent. We have not heard whether the shareholders have made up their differences with the directors, or whether the company can yet be said to have lost the unenviable distinction of being the worst managed of all the German railroads.

The line, however, which at the present moment justly excites the greatest interest in Germany, and which to England is of more importance than all the other German railroads put together, is the projected line from Hamburg to Berlin, of which as yet only a few miles have been completed, viz., from Hamburg to Bergedorf. The enterprizing mercantile community of Hamburg were, if we mistake not, the first in Germany to bestir themselves for the establishment of railroads, but encountered so many obstacles in the jealousy of their neighbors, that one plan after another was abandoned in dispair. It was at length, however, determined that so much of the line towards Berlin as ran upon their own territory should be executed at all events, and they calculated that when a commencement had been made, they would find it all the easier to overcome *personal* objections. All opposition on the part of Denmark and Mecklenburg has gradually been overcome, the political difficulties to the undertaking have been all obviated, and nothing now remains but to raise the necessary capital in order to proceed with the construction of the railroad.

In ordinary times there would be no difficulty in obtaining, in Hamburg and Berlin, purchasers for all the shares in such an undertaking as a railroad intended to connect the two cities; but at the present time several circumstances contribute to impede the prompt filling up of the subscription list. The calamity which befel Hamburg last May is still severely felt there, independently of which Hamburg has largely participated in the effects of that commercial depression under which England has now been suffering for so considerable a time. Many of the citizens of Hamburg have passed from affluence to poverty in consequence of the great fire, and many more are probably still struggling to conceal from the world the state of insolvency to which that calamity has reduced them. Capital is, therefore, necessarily less abundant in Hamburg now than in more prosperous times, and other circumstances contribute just now in Germany to invite the investment of surplus capital in other undertakings. The king of Prussia has projected a colossal system of railroads to radiate from his capital towards the extreme points of his kingdom. Many of the lines which he has determined on, and which have received the sanction of the States, however important they may be in a political or military point of view are not likely to produce much

profit to those who would make them at their own risk; the king, in order, nevertheless, to insure their construction, has guarantied to the capitalists who will undertake them a minimum interest of three and a half per cent. This guaranty fund is not to be extended to the line from Berlin to Hamburg, which has been looked on by the Prussian government as so secure a speculation that no guaranty from the State would be requisite to induce capitalists to enter upon it. Eventually this anticipation will no doubt be fully justified; but in the mean time, what may be called the State railroads in Prussia, will by many be deemed a safer investment, the Prussian government guarantying the dividends on the shares, not merely from the time when the railroads shall have been completed, but from the day when the works commence.

In addition to these circumstances, there are certain local jealousies and rivalries that are exerting such means as they have at their command to delay, if they cannot wholly prevent, the construction of the railroad between Hamburg and Berlin. When the lines now in construction are completed, there will be two great lines extending, the one from Trieste, over Vienna, Prague and Dresden, to Antwerp; and the other from Trieste, over Vienna, Breslau and Berlin, to Hamburg. Should the line to Antwerp be finished sooner than that to Hamburg, there can scarcely be a doubt that the Antwerp line would become the main artery for German commerce, and that much of the trade of Hamburg would be drawn off by her Belgian rival. It may be worth while to present the present state of these two lines to our readers in a tabular form.

| | Ready. | In construction |
|---|---|---|
| From Trieste to Gloggnitz, | | 50 miles. |
| From Gloggnitz to Olmutz, | 40 miles | |
| From Olmutz to Prague, | | 32 miles. |
| From Prague to Dresden, | | 20 miles. |
| From Dresden to Magdeburg, | 30 miles | |
| From Magdeburg to Hanover, | 20 miles | Not yet opened, but certain to be opened in a few months. |
| From Hanover to Cologne, | | 48 miles. |
| From Cologne to Antwerp, (or Ostend,) | 40 miles. | |
| | 130 miles. | 150 miles. |

Of the line from Trieste to Antwerp, therefore, 130 (German) miles of railroad are complete, and 150 miles remain to be executed; but of the construction of these 150 miles, within a brief space of time, there can scarcely be a doubt, now that the Austrian and Spanish governments have taken the respective lines under their powerful protection. Whether these governments are acting wisely, in burdening themselves with a guaranty which must have the effect of adding to the national debt of either country, time alone can solve.

The following is the present state of the line from Trieste, over Vienna, and Berlin, to Hamburg:

| | Ready. | In construction. |
|---|---|---|
| From Trieste to Gloggnitz, | | 50 miles. |
| From Gloggnitz to Leipnick, | 40 miles | |
| From Leipnick to Oppeln, | | 20 miles. |
| From Oppeln to Breslau, | 10 miles | |
| From Breslau to Frankfort-on-the-Oder, | | 34 miles. |
| From Frankfort to Berlin, | 10 miles | |
| From Berlin to Hamburg, | | 36 miles. |
| | 60 miles | 140 miles. |

On the former of these lines, it will be seen, a much larger portion of the work has been completed, a larger amount of capital has consequently been invested, and a powerful rival interest is organized, which will do what it can to deter the timid from investing their funds in a railroad from Berlin to Hamburg. Bohemia, Saxony, Hanover, the Prussian provinces on the Rhine, and Belgium are interested, or believe themselves to be interested, in defeating the Hamburgers, and the consequence has been an active paper warfare, which has of late been extended even to England. Calculations are constantly published in the newspapers with a view to demonstrate the improbability of a remunerating traffic, and a friendly uneasiness is even expressed lest some unfortunate dupes should be prevailed upon in England to throw away their money on so hopeless an undertaking. An instance of this occurred in our own paper, on the 8th instant, when *an advertisement* of some length was inserted in the shape of a letter, purporting to proceed from an Englishman at Berlin, who was made to give expression to sundry apprehensions lest the purses of his confiding countrymen should be laid under contribution. We have no objection to warnings of this sort. John Bull has, in his time, been seduced to invest a deal of his hard earned money in the purchase of moonshine, and it will be better for him in future to be too cautious than too confident; at the same time, well aware of the quarter whence these warnings proceed, and of the motives that dictate them, we are not inclined to attach much importance to them, or to feel any deep obligation to their authors.

There is no city on the continent in whose welfare England is more interested than Hamburg. Our exports to that city average annually from five to six millions, (nearly the whole being cotton and woollen manufactures and hardware,) and every additional facility of communication with the interior must have the effect of increasing so profitable a trade. The railroads, terminating at Antwerp, run, moreover, through no part of Germany, but the States embodied in the Customs Union; whereas, nearly half the line from Hamburg to Berlin passes through Danish and Mecklenburg territory, where the duties on British manufactures are comparatively trifling, and are likely to remain so, neither of these two countries having any manufacturing interests to protect, and both of them being deeply interested in cultivating a commercial intercourse with England for the disposal of their agricultural produce. The moment either line is complete to Trieste, that line must become the road from England to India, in preference to that over Paris and Marseilles; but there are many reasons why the line from Hamburg over Berlin, about 900 English miles in length, would be preferable to that from Antwerp, over Dresden and Prague, which would be at least 1,260 English miles long.

The people of Hanover look to England for some assistance in carrying out their railroad, in the realization of which they think England almost as much interested as themselves. Individual capitalists, however, will be guided by the prospects of profit only; and of all the continental railroads we know of none that promises better. At the termini of the line we have a population amounting to more than half a million of souls; and although no large city occurs on the way, yet at both extremes the railroad will come into communication with an intercourse of wide extension and first rate importance. The country, moreover, through which the railroad will run is nearly a dead level, and it may be doubted whether there is any railroad of the same length, in any part of the world, in the construction of which fewer natural difficulties have presented themselves, than may be looked for between Hamburg and Berlin. All the railroads terminating at Berlin,

and now in activity, have turned out profitable undertakings, and of all, the shares are now at a considerable premium.

The companies interested in the steam navigation from Hamburg to Magdeburg are also active in their exertions to prevent the realization of the railroad from Hamburg to Berlin, though it may be doubted whether the river traffic, particularly with the steamers, would not continue with nearly the present activity, even if the railroad were in full operation. The travelers to Saxony, Bohemia and Central Germany would still continue to journey up the Elbe to Magdeburg.

The Leipzig-Dresden line has published its annual report, and a very satisfactory report it is for the shareholders. The dividend for the last year is to be 6 per cent., and the estimates for the coming year promise a considerable increase in the receipts, accompanied by a considerable reduction of expenditure. The receipts of 1842 showed an increase of 50 per cent., as compared with those of 1841. Till recently this railroad had been working with a single line of rails. The second line is now completed, and will allow a greatly increased activity. Branch lines are spoken of from Leipzig to Chemnitz, and from Dresden to Chemnitz, as likely to be undertaken in the course of the present year.

No German government is exerting itself more zealously in the cause of railroads at present than that of Austria. The report of the Vienna-Raab company for the last year appears to have been quite an agreeable surprise to the shareholders, who, if we understand aright the abstract that has appeared in a German paper, have received five per cent. interest on their capital, independently of a half per cent. which had been paid over to the reserved fund. The works of the government, however, will in a short time give increased value to this line. The works for the extension of the line to Trieste are in active progress, and so, at the other extremity, are those for the extension of the Vienna-Olmutz railroad to Prague. A treaty has been concluded with the Saxon government for the railroad from Prague to Dresden; so far, therefore, as Austria is concerned, the railroad from the Adriatic to the North sea has been provided for. Even during the winter, from five to eight thousand workmen have been constantly at work on the Bohemian part of the line, but on the return of spring it is intended to strain every nerve to accelerate the great undertaking.

A new German railroad, that between Heidelberg and Carlsruhe, will shortly be opened as far as from Heidelberg to Langenbrucken, a distance of about fifteen miles. Experimental trips were performed on the 26th and 27th ultimo, but we have not yet seen any account of the railroad having been opened for the use of the public.

In the kingdom of Wurtemburg, also, the government has very splendid schemes, which will probably be realized, but not without imposing a considerable additional debt on the country, in the shape of a guaranty fund to the capitalists who advance their money. There are to be private railroads and State railroads in Wurtemburg; the former are to be undertaken by companies, to whom the government guaranties an interest of four per cent. on the capital advanced, reserving to itself, however, the right of buying up the railroad on payment of the money expended on them. The State railroads are to be constructed by the government, and a loan is to be raised to defray the expenditure. Among the lines recommended by the committee of the second chamber is one to connect the Rhine and the Danube, from which several branches are intended to radiate

In looking at the immense works now in progress in Germany, it is impossible to forbear from speculating upon the vast results that must in a few

years be obtained. With a railroad 900 miles in length it will be quite practicable to travel from Hamburg to Trieste in forty or fifty hours, and thus a saving of several days will be effected in the transit of the overland mail from India to England. The whole system of continental travelling, moreover, must undergo a change; for it will be intolerably absurd to make a man waste days at a railroad station on the formalities of his passport, when in the space of time thus lost he might have travelled from the North Sea to the Adriatic. Will not even the national character be likely to undergo a modification when such rapidity of locomotion has become one of the accustomed occurrences of life in every part of the country?—*London Chron.*

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It may not be known to some of our readers, that at the late session of the legislature, an attempt was made to procure a charter for a railroad from New York to Albany and Troy, to be located immediately upon the eastern bank of the Hudson river. This, of course, would have been a rival line to that of the New York and Albany railroad, and in endeavoring to forward their application, the advocates of the "river line" have not hesitated to make the most absurd statements in comparing the two routes. The report from the committee to whom the matter was referred, very properly put the project to sleep—and in doing so, has not spared the absurdities and inconsistencies of the petitioners. Among other things, they quote the very words of a former report of the engineer who now advocates the river route, in which he took ground diametrically opposite to that which he now takes.

In answer to some of the, so called, arguments brought forward, Mr. E. F. Johnson, chief engineer of the New York and Albany railroad company, prepared a statement, which was presented to the legislature. As this paper of Mr. Johnson's touches in one place upon a point of professional interest, we have selected a few paragraphs for publication.

"The river line is also represented to have a maximum grade or inclination of thirteen feet less per mile. Assuming this statement to be correct, it does not by any means follow that any very material advantage is derived therefrom to the river line, either in the average velocity of movement or in the cost of transportation.

Both routes have their termini upon the *same level.* If, therefore, there is more ascent upon one line, it must also have an equal surplus of descent, so that the aid afforded by gravity in the latter case will be precisely equal to the resistance in the former.

For the purpose of illustration, let it be supposed that the rate of ascent on the two lines, for a given distance, to be equal to the maximum on both, namely, thirty feet per mile on the one, and seventeen feet per mile on the other. If with a given power a given load is conveyed up the latter at the rate assumed, of twenty-six miles per hour, the same power will convey the same load up the former at the rate of twenty-three miles per hour, nearly, (see the New York Assembly Documents, No. 133, page 11, 1839,) making a difference in the speed on the ascent of three miles per hour. If these grades occupy half the whole distance, and the journey between the two extremes is performed in six hours, the train which is on the lowest grade will commence its descent about nine miles only in advance of the other, or twenty minutes sooner in time. To make up for this loss of time, on the remaining half of the distance, the train on the thirty feet grade has the bene-

fit, in its descent, of the greater force of gravity on that slope, compared with the slope of seventeen feet per mile; and hence the whole distance will be accomplished with the same expenditure of power in the the same, or very nearly the same time.

If the rate or degree of inclination of the grade line was so great in any part as to render it impossible, from considerations of safety, to derive the full benefit of the aid afforded by gravity on the descending portion, the result would be different and a disadvantage might ensue; but such is not the case where the maximum inclination does not exceed the limit of thirty feet per mile, the average much below that amount.

Admitting it, however, to be possible that some little difference may exist in favor of the lower grade on the river line, yet it cannot be denied that the interest upon the superior cost of that line, amounting probably to not less than $50,000 per annum, will manifold more than cover the difference in the expense of fuel, or whatever extra power of traction is needful to convey the same load with the same average speed over the interior route.

So far, therefore, as it regards the *through* trade and travel, the interior route will be found to be quite as efficient as the other. This conclusion is in accordance with the experience on all the railways in operation of a similar character, having grades not exceeding thirty feet per mile.

I am aware that the opinion has been advanced that a difference in the elevation of a summit of from seventeen to twenty-five feet per mile is equal, when *equated*, to one mile of horizontal distance.

For very high grades and high summits this rule, *arbitrarily assumed*, might not be widely at variance with the truth; but where the grades range below the limit of thirty feet per mile, and the average, as is the case on the interior route between New York and Albany, does not exceed more than half that amount, the rule is not in the least degree applicable.

With respect to the *way* business, which, if we may judge form the experience upon the New York and Erie and other roads, must constitute a considerable portion of the whole business of the New York and Albany road, the superior elevation of the ground on the interior route will be found an advantage rather than otherwise. This is evident from the fact that the region of country which will furnish a surplus produce for market, is elevated considerably above the line of the road. The road is therefore more accessible from the surrounding country from having this elevation, and will be more likely to obtain in consequence its fair share of business in competition with the river.

There is another and still greater advantage to be derived. The most elevated portion of the interior route is situated, as already stated, near the north line of Dutchess county. From that point to New York city, the grade has an average descent of eight feet per mile for one hundred miles. Nearly all the way freight, forming possibly the greater portion of the freight conveyed in summer, will come to the road in this distance, and as the average descent is in the direction of the preponderance in the trade, being towards the city, more will be gained than lost, in consequence, in the expense of transportation. * * * * *

As to the amount of way business to be furnished to the railroad, it must be remembered that the proposed river route can only draw to its support that which flows in from *one side*, which for eight or ten months in the year must be divided with the steamboats and other craft upon the river. * *

It should be borne in mind, in considering the relative merits of the two routes, that the river line will not serve to cheapen the transportation of produce to the city from the eastern river counties, neither does it in the least

accommodate the rich marble and iron region which lies in and near the valley through which the interior route passes. * * *

The interior route also passes through a region at present deprived of any convenient mode of communication with the city."

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CHESAPEAKE AND OHIO CANAL.

At a general meeting of the stockholders at Frederick, on the 5th instant, we understand proposals were submitted by capitalists for completing the unfinished portion of the canal between dam No. 6, and the town of Cumberland, as also for the extension of the work to the mouth of Savage. But it will be seen by the annexed report, that the company deferred entering into any contract before affording a reasonable time for any other persons to offer proposals, and thereby release the directors from any censure that might possibly accrue to them, as well as to afford the authorities of the State an opportunity of carrying out the provisions of the legislative enactment with regard to the sale of the work. We think the proper course to be pursued is here marked out, and such an one as will meet the approbation of the friends of the canal.

As to the prospects of the work on the canal being commenced soon, we of course cannot speak positively. We learn that General M'Neill, the president of the company, is still very sanguine in his expectations—that he says the work *will go on soon*, and that, too, to *completion*. We sincerely hope he may succeed. We are indebted to our Baltimore correspondent for the following report.

REPORT.

The matter of the report divides itself into two distinct subjects:—

1st. The accounts, expenditures, sales of property, income from tolls, etc., or in general of the finances of the company. It has not been in the power of the committee to bestow upon these subjects the attention which their importance demands. We beg leave, therefore, respectfully to recommend that a committee of three be appointed by the chair to attend to this part of the president's report.

2d. Of the extension of the canal. We are of opinion that the interest of the State, and all interests connected with or to be developed by the canal, are eminently involved in the early and substantial extension of the canal, in conformity with its plan up to the town of Cumberland, and that to this end the energies of the president and board of directors should be directed with vigor and perseverance.

With this general expression of opinion the committee will bring to the consideration of the meeting the necessity of observing certain precautionary measures, which will now be indicated.

1st. That competition ought to be excited by public advertisement in the newspapers before contract be entered. Proposals to be received by the 26th June.

2d. No attempt should be made by the company to purchase State bonds until the treasurer shall have failed to effect a sale of the State's interest in the canal as authorized; say until the 10th July.

3d. That no contract shall be entered into except with the condition that it may be annulled by the company after thirty days' notice, at any time within twelve months after the date of said contract, on the payment of one per cent. as damages upon the unexpired portion of the contract.

4th. Provided, however, that nothing whatever shall be done by the president and board of directors which may prevent or embarrass the sale by the State of Maryland of her interest in the canal.

True copy of the report of the committee upon the report of the president and directors of the Chesapeake and Ohio canal company, submitted to the stockholders, etc., made June 6th, 1843.

Test. THOS. TURNER.

At the same meeting the following gentlemen were elected officers of the Chesapeake and Ohio canal company for the current year.

Gen. W. GIBBS MCNEILL, *President.*

*Directors.*

Col. Frisby Tilgham, } Washington county.
John O. Wharton, Esq. }
William Price, Esq., Allegheny county.
Col. James M. Coale, Frederick county.
Daniel Burkhart, Esq., Berkely county, Virginia.
J. P. Ingle, Esq., Washington city.

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We have long since expressed our opinion that the Long Island railroad was destined to become one of the most important lines of improvement in the country. From the report now before us, we are pleased to learn that there is a fair prospect of an immediate completion of the work. The amount required for this purpose is but about half of the portion of the capital which yet remains to be called in. For the particulars in regard to cost of construction, etc., we refer to reports themselves.

We cannot but regret that the company have neglected contributing their share to the general fund of information, by not giving the details of expenses of conducting the road. It is true that the line is as yet incomplete, but this is no reason for the omission.

We have not included in our extracts that portion which refers to the prospective traffic of the road, as it was published in the last report. It does not, however, need much argument to convince even the general reader that a very liberal share of the travel east of New York will pass on this road. There is, however, one item which, from the results of our own observation, we feel convinced the directors have underrated—we refer to the local traffic both in freight and passengers. The company have based their calculations for this portion of income, upon the actual receipts for the road as at present in use. That this is far short of what it should be, we suppose the directors themselves do not doubt, and as any one may learn from the fact that several lines of stages do a good business along side of the railroad—in some cases even at a higher fare than that of the railroad. The mere question of undervaluing an item in the prospective business of the road, is of not great importance, and would, doubtless, at some future time, prove a very welcome discovery. But from the little attention this branch of their income has received from the directors, in their report, as well as from the system of management, we feel certain that an increase of attention to this point would result in an increase of profit. It is in vain to say that every exertion should be made to complete the work—this is all well enough—but is it a necessary consequence that the exertions to secure travel upon that portion of the work already completed, should not be made? This would indeed be a queer law,

and one that would forbid any care being bestowed on a road when finished. But a neglect of part of a work, is a neglect of the whole, in the moral, though not in the mathematical sense—and that which is productive of injury to the reputation of a part, is injurious to the whole road. With this view of the case we see far larger and more encouraging prospects than even the most sanguine hopes expressed in the report, would indicate. Upon Long Island alone, a traffic exists in part, and in part is yet to be created, that shall far exceed the most ample share of the eastern travel, ever likely to fall to the share of any one line of railroad or steamboat. Nor do we mean to doubt the estimates upon this point, there is no line of those in operation which can in any way offer the advantages belonging to this, and if nature had endeavored to form land for railroad uses, she could not have produced a better specimen than that traversed by the Long Island railroad.

LONG ISLAND RAILROAD.—REPORT OF DIRECTORS.

The capital of the company, as granted by their charter, is $1,500,000, in 30,000 shares, of $50 each. Of this amount, $28 25 per share has been paid by the stockholders, and the amount has been expended in the construction of the road, leaving $21 75 per share, or $653,500 still unpaid.

In giving a statement of the property and effects of the company, it will be proper to state that the road, as far as constructed, is of the permanent description, being laid with the heaviest solid rail of 56 lbs. to the yard, with a heavy superstructure laid the whole distance upon a deep gravel foundation.

The property of the company consists of 31 miles of road with the necessary appurtenances, consisting of turnouts, tables, car and engine houses, machine and blacksmith shops, store houses, dwelling houses, 12 in number, stables, offices, 20 lots of ground in Brooklyn, (Parmentier's garden,) and 50 lots in Jamaica, the Hempstead branch railroad of three miles, 4 locomotive engines, 15 passenger, and 30 burden cars, etc., the right of way for the construction of the road for a distance of nearly 30 miles, and the road-bed graded and prepared for the rails for a distance of 21 miles. The whole work and property having been obtained at a cost rising one million of dollars.

The debts and liabilities of the company are as follows, and payable at the periods stated, viz:

| | |
|---|---|
| To the State of New York, payable in 1861, | $100,000 00 |
| In a second mortgage on the road, being a debt originally contracted to the Morris Canal and Banking company, of $60,000, of which $20,000 was paid, and the mortgage for the balance of $40,000 is now held by A. G. Thompson, with whom an arrangement has just been concluded to defer the payment for 4, 5, 6 and 7 years, | 40,000 00 |
| Bonds issued in 1840 at 10 years, at 6 per cent. interest, for the Hempstead branch, | 12,861 44 |
| Bonds for rent and interest to the Brooklyn and Jamaica R. R. Co., payable in 10 years from June, 1842, | 57,922 00 |
| Four year bonds issued to contractors, and for materials, due in 1845, 1846 and 1847, | 37,309 06 |
| Bond issued for iron, locomotive engine, materials, etc., due within the next six months, | 12,384 24 |
| Bonds at 10 years, issued to residents of Long Island, for money loaned at 6 per cent., and expended in the construction of the road, | 16,825 00 |
| | $277,291 73 |

The receipts and expenditures of the road, as far as constructed, and operated upon from May 1842 to May 1843, are as follows:

| | | |
|---|---|---|
| Receipts for passengers, | $46,241 63 | $55,731 84 |
| Receipts for freight, | 9,490 21 | |
| The expenses for the same period are, | | |
| Interest on New York State loan, | $6,000 00 | |
| Interest on State of Michigan, | 1,506 62 | |
| Rent to Brooklyn and Jamaica railroad company, | 8,000 00 | |
| For all other purposes, as expenses proper in conducting the road, including repairs, | 37,134 74 | 52,641 36 |
| | | $3,090 48 |

The balance of $3,090 48, together with two instalments, of one-half per cent. each, or $14,500, called during the past year, has been expended in continuing the construction of the road, and for which sum, as well as all other moneys expended, vouchers are on file.

The distance from Brooklyn to Greenport, the proposed terminus of this road, is 95 miles; the portion now in operation from Brooklyn to Suffolk station, the present terminus, is 46 miles; of the remainder, 21 additional miles are graded, 16 of which are in direct continuation, and 5 miles more are graded at different points on the line and disconnected.

The terminus at Greenport, from which point it is proposed to connect with the eastern roads by steamboats, is of the most favorable character; the approach to it is on the direct line of the road, and trains may be run upon the wharf at that place, at which ships of 500 tons are moored, and from which steamboats of any draft of water may take passengers with baggage and burden cars at all times throughout the year.

It may be well to add that with a view to making Greenport the terminus of the road, it has been recently examined by a committee highly competent to judge, that this committee have unanimously decided it to be all that could be desired for that object.

The distance from Greenport to Stonington is estimated at 24 miles; and about the same number of miles to the proposed terminus of the Norwich and Worcester road, near Gales Ferry, to which point the latter road is under construction, and will be completed in November next. The time required for performing the distance from New York to Boston, on the completion of this road, may be stated as follows:

| | |
|---|---|
| From New York to Greenport, 95 miles, | 4 hours. |
| Crossing to the Norwich and Worcester or Stonington roads, | 2 hours. |
| From thence, as now performed, to Boston, | 4 hours. |
| | Making 10 hours. |

Annexed to this report will be found the report and estimate of the engineer of the work, James J. Shipman, Esq., by which it will be seen that the cost of completing the remaining portion of the road to Greenport is $350,000.

No amount is named in the estimate referred to, as required for the *right of way;* and it is believed that none, of any moment, will be required. The land has been ceded, for the most part, and in two cases only on the twenty miles of road recently constructed, where the owners of land were unwilling to give their land, the commissioners appointed to assess the damage gave but a nominal amount, probably holding in view the great advantage which would accrue to such land owners by the construction of the road.

The company have recently obtained a decision of the vice chancellor, by which they are relieved from the heavy expense of constructing fences

along the line of the road. This item of expense alone in the construction of the road has heretofore reached as high as nearly $2,000 per mile.

It is proper here to add, without claiming more for this road than other roads may claim, that from the period of its first operation to the present time, upwards of 750,000 passengers have passed over it without injury to a single individual. * * * * * *

Having placed before the stockholders the condition and prospects of the company, they would call their attention to the report of the engineer with regard to the cost of constructing the remaining portion of the work. By this estimate it appears that the sum of $330,000 is necessary for that object. By the experience acquired in the construction of 20 miles of road within the last 18 months, it is believed that the estimate is a fair one, and that of this sum, $250,000 would be required in cash, and that the balance could be obtained on a credit of from 1 to 4 years.

If the estimate referred to be correct it would seem for the interest of the stockholders to have the road completed as early as it could be done, consistently with a due regard to economy.

It is proper to state that some of the stockholders are urgent upon the board to complete the road with all practical dispatch, and place the company in a condition to pay dividends; and they also contend that the present condition of the money market, and the low price of materials, are unusually favorable for that object, and those holding these opinions profess their readiness to pay on their own stock. These representations coming from responsible sources, are doubtless entitled to some weight. The board of directors wish to pursue only such a course as will conduce to the immediate and permanent interest of the stockholders and the public.

The board are of the opinion that the time has now arrived when it becomes expedient to make a vigorous effort to complete the Long Island railroad from its present terminus to Greenport, and which can only be done with a due regard to economy, by raising funds from the stockholders sufficient to meet the expenditures. The president has accordingly been authorized and directed to call an instalment of one dollar and a half per share, payable on the 1st July next.

This matter is now submitted for the mature consideration and decision of the stockholders, with the single remark, on the part of the board, that in every view which they have been able to take of the subject, the conclusion is irresistible, that the expenditure upon this road, of the sum stated, will immediately and permanently enhance the value of the stock far above its present cost, and bring into successful operation a work, the extent and productiveness of which, (with a single exception,) it is believed, will exceed that of any other road in the middle or northern States.

By order of the board,

GEO. B. FISK, President.

*New York, June* 15, 1843.

ENGINEER'S REPORT.

*To the President and Directors of the Long Island Railroad Company.*

GENTLEMEN—I have the honor of submitting the following brief report and estimate of the cost of the graduation and superstructure of the Long Island railroad from its present termination in Suffolk station to Greenport.

In making this estimate I shall omit taking notice of the cost of right of way, and the necessary docks and other fixtures required at Greenport, for which I have no data, and I shall take the present contract prices, considered as payable wholly in cash, as the basis of my estimate, the cubic yards

of excavation being increased to cover the grubbing and clearing. The item of masonry is also omitted because we have but two culverts on the line of more than 12 feet span, and those, owing to the entire absence of stone along our line, are made of timber truss work, the cost of which is estimated under the item of superstructure.

*Estimate of excavation from 2d division to Greenport.*

| | | | |
|---|---|---|---|
| 690,500 | cubic yards at 8 cents per yard, | - - | 55,240 00 |
| 250,000 | " " completed at 8 cents per yard, | - - | 20,000 00 |
| 440,500 | " " balance unfinished at 8 cents per yard, | | $35,240 00 |

I submit also an estimate of the superstructure:

| | | | |
|---|---|---|---|
| 4128 | tons iron rail and spikes at $60, | - $247,680 | |
| Mud sills and ties for 48 miles at $420 | | - - 20,160 | |
| Workmanship, | " " at $400 | - 19,200 | 287.040 00 |
| | | | $322,280 00 |

I would also state that the character of the graduation is such that it may be completed nearly as fast as the iron can be laid down, and that the retracing of the line beyond Jamesport would require a month or six weeks time, while the whole line from Jamesport west is now ready for the contractor. The whole line can be completed as respects graduation in four months without any question, and we have at this moment twenty-three miles in readiness to receive the superstructure.

The condition and prospects of the work under your direction will, I conceive, justify me in congratulating the stockholders and directors upon the near prospect of its early completion. The whole extent of our country, from one extreme to the other, will not present a line possessed of similar advantages, its western terminus at two great cities, Brooklyn and New York, the mainsprings of energy and enterprize, with a population of 360,000—its construction through the centre of an island itself containing 100,000 inhabitants, entirely free from navigable rivers, without a bridge for an hundred miles, and with grades of an average less than ten feet per mile; having six curves only, with radii not less than 5000 feet in 80 miles, admitting of any desired velocity, and with its eastern termination on one of the most beautiful harbors in the Union, within 5 hours of the city of Boston in all weathers. We may in brief, sum up the advantages you possess to enable you to withstand all competition in the following particulars, the shortest possible distance, the greatest velocity, the most perfect and solid superstructure at an expense less by 40 per cent. than any similar road in the world, and finally, a capacity of performing a profitable business at the lowest prices. All these are advantages inherent in your enterprize; and entirely independent of all improvement in machinery, which other machines may supercede, for no invention can nullify the fixed and immutable laws of nature; these devices serve only to economize power by new modes of application, which, owing to your unrivalled position, will still farther increase your capacity for business. I cannot believe that an enterprize so full of the elements of success will be suffered by the intelligent and active officers at the head of its affairs any longer to linger out a sickly existence when the land of promise so invitingly lies before them, and nothing more is required than to reach forward and possess that which they have so manfully struggled to obtain.

Respectfully submitted,

JAMES J. SHIPMAN, Chief Engineer.

## READING RAILROAD AND THE COAL TRADE.

We were not a little surprised to find, while on a visit to Philadelphia a short time since, an apparent hostility among the citizens to the *Philadelphia, Reading and Pottsville railroad.* That there should be among those interested in rival works, a degree of hostility towards this road, which is likely to prove so formidable a rival, is not very surprising, but that others, whose interest is apparently in no wise interfered with, should evince hostility to *such* a work, is truly surprising. It is said by some that the Schuylkill Navigation company could bring down all the coal that can be mined in the Schuylkill region, and therefore a railroad was unnecessary. Possibly all the coal of the Schuylkill region might for some years yet, come through the canal, and at the old price of $2 00 per ton, yet, even if it might, that is no reason why other means of transportation should not be prepared *in time*, by which the supply of coal may be increased, and by competition—aye *competition*, there's the rub—in transportation, as in mining, the *price reduced.* It is hardly to be supposed that consumers will find fault with a measure which tends directly to reduce the cost of coal, unless perchance they have interests adverse to a reduction, either in *coal mines*, or other *modes* of transportation, yet we found many individuals who appeared decidedly opposed, if not hostile to this great work, which promises to be of vast benefit to community, by a direct reduction in the price of coal, the consumption of which is rapidly increasing in all parts of the middle and eastern States.

In 1842, over 540,000 tons of coal were sent from the Schuylkill mines, by canal and railroad, and it is now believed that over 600,000 tons will be sent this year. The cost of delivering this coal at Philadelphia, on the wharf and on board vessel was, previous to the competition of the railroad, over two dollars per ton; now by the railroad, it does not exceed $1 40—thus effecting a saving to the consumers of the 540,000 tons shipped last year of $324,000, and this saving was effected by the Reading railroad. Boats of the Schuylkill Navigation company are now carrying for 70 cts., and toll 54 cts. per ton, which with the unloading and re-shipping on board vessels at Philadelphia makes it over $1 40 per ton on board of vessel or in the depot of the company, thus making a saving to the consumer on the 600,000 tons from the Schuylkill region of $360,000 the present year. But this is not all the advantage, or economy to the consumers of coal. The whole amount of coal sent from the entire anthracite region of Pennsylvania in 1842, was 1,108,001 tons, only a fraction more than *double* the amount from the Schuylkill region alone. The Schuylkill is, we believe, the favorite in every market—of course, then, a reduction in the price of Schuylkill, of which so much is used, will carry all other kinds with it, and, therefore, we may safely assume that the Reading railroad has produced a saving to the consumer of sixty cents per ton on the entire amount sent to market, which will, this year, no doubt, be equal to, if not greater than last year—and amount to over $600,000.

But to understand fully the value of this improvement, we must look to the future. The *entire* consumption of anthracite coal in 1822, was only 2,240 tons—of which not a bushel came from the Schuylkill mines. It was not till 1825 that coal was sent to market from that region which now supplies one-half, into a few tons, of the entire consumption. In 1832—363,871 tons were sent to market—in 1842, 1,108,001 tons—may we not assume that the increase will keep pace, for ten years to come, with the past ten? and that in 1852, there will be at least 2,500,000 tons sent to market? We think so—and that they will be prepared to transport from the Schuylkill region, and deliver it on board of vessels, or in the yards at Phil., for $1 12½ per ton.

It is asserted by some that the railroad cannot compete with the canal—and, therefore, that it can never succeed; as to *competing* with the canal, *that*, we presume, is not the object of the railroad company. We suppose their intention is to carry the coal to tide water at a price, and in a *manner*, satisfactory to the dealers, and we have no doubt of their ability to do so, when they shall have laid their double track from Reading to Pottstown, and have increased their cars and engines according to their present designs.

Few people, indeed, who have not visited this railroad, can appreciate its great advantages for heavy transportation. The entire line from Pottsville to Falls of Schuylkill, 88 miles, is either level or descending, and, therefore, with *good* cars and engines, there is scarcely a limit to its capacity to transport coal, as will be seen by the statement, on another page, of Mr. G. A. Nicolls, superintendent of transportation, in relation to the performance of "Monocacy," a locomotive built by the Newcastle Manufacturing company, at Newcastle, Delaware. It is believed that that engine would have readily taken *twenty* additional cars; making up the load to 400 tons nett, exclusive of *cars*, and without injury to the road—thus establishing, beyond question, that they may at all times rely upon good engines' taking 200 tons of coal, or 66 cars, and more if necessary; and thus with thirty locomotives for freight and 2,500 coal cars, they can average *ten trains* a day, or 12,000 tons a week, or 600,000 tons a year—allowing two weeks for snow storms—which at $1 40 per ton, gives $840,000 a year for coal alone, without reference to passengers and ordinary freight, which will, in a few years, become an important item. It may be said that this calculation cannot be realized at *present*, and it may be as truly said that in ten years, and much less, it *will* be realized, and *exceeded* by fifty per cent.

It is said by some that this road cost too much. It has truly cost a *large* amount of money, over $5,500,000. Yet it must be taken into the account that the great object in view has been to obtain the *most favorable* grade possible, for a *heavy* trade *one* way, and to accomplish this, *rivers* have been bridged, *vallies* filled up, *hills* cut down and *mountains tunnelled*. The gentlemen in charge have judged wisely that for a heavy trade, a *good* road was necessary, and they have made such a road—notwithstanding the natural difficulties, the unceasing opposition, and the general depression of business operations for several years past.

There are three tunnels on this road, one 962 feet, one of 1,600 feet and one of 1,932 feet in length, by the last of which a bend in the river is cut off and the distance of several miles saved. The passage through this splendid tunnel and over the river, on a beautiful curved stone bridge, as the train emerges from total darkness at great velocity, is truly grand; and indeed the beautiful and highly cultivated valley of the Schuylkill nearly the whole distance to Pottsville, and the great variety of beautiful scenery constantly presenting itself to view when approaching the coal region is exciting beyond description. The passage of boats on the canal, loaded with coal, in one direction, at three miles an hour, while the cars are going at the rate of 20 miles in another; the assembling of cars loaded with coal, on the railroad from different directions; and the puffing of half a dozen locomotives, waiting with long trains of cars attached, for the arrival of the up train; the delightful and bold scenery breaking upon the view as the train winds among the hills, and the flourishing busy village of Pottsville, all tend to render this one of the most delightful excursions that can be enjoyed in the vicinity of Philadelphia; and a little effort and management and perseverance are only necessary, to render it one of the most frequented by the lovers of nature and the country—until the vicinity of the railroad becomes studded with beautiful country seats. But to effect this the system of "*low fares*" must be adopted. And here a word to the managers of the road, which, however, we must defer until our next number.

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## UNITED STATES NAVY.

The Army and Navy Chronicle presents the following *glowing* picture of the condition and mismanagement of the United States ships of war. It cannot be denied that there has been a gross waste of money in this department of our government—especially in the abortive early attempts at *steam frigates*. If the government would contract with individuals or companies for the construction of a few steam vessels of the various descriptions desired to come up to a certain standard—or not to be taken by the government—and then give *future* contracts to the most successful competitors, we will guarantee that as many steam ships, of the most improved construction, as may be desired by the government, will be furnished at three-fourths, or even *two-thirds* the cost of those built at the navy yards, where it is well know that labor does not *always* produce the greatest effect.

### A GALVANIZED STEAMER.

Besides the sloop of war that has been ordered to be built at the Washington navy yard, we understand preparations are making also for building an iron man of war steamer. We have not understood what is to be her size—*small*, though, we hope. This business of steam men of war is new, and our true policy with regard to it is contained in the Spanish *refran*, *poco a poco*, senores. In the building of the Mississippi and Missouri, we have overshot the mark; precisely as we did in laying down the keels of so many 74s just after the war. There was the Independence, 74; she performed one short cruise, we think it was; and to be of any service had to be razeed down to a frigate. There is the Washington, 74; she has been once to the

Mediterranean and back, and she has now to be broken up as not worth repairing. There is the Franklin, 74; she has been one cruise to the Pacific, and a short time in the Mediterranean. She is hogged, and is now to be sent round to Boston, (*if the New Yorkers will let her*, for they have been making great efforts to retain her there,) to be cut down into a frigate. Then there is the Columbus, 74; she has also performed but one or two cruises, in a life time of twenty odd years, and will, when she returns, perhaps, never perform another as a ship of the line. There's the magnificent 120 gun ship, the Pennsylvania, rotting at her anchors; and we have heard doubts expressed as to whether she would even now be sea worthy; at all events, it is a question which in all probability will never be put to the test, unless we should have war very speedily. The Ohio has been in the water for twenty odd years, and has been one cruise. The Delaware is now abroad and the North Carolina is at New York. Besides these, there are on the stocks, where they have been kept since the war fever for 74s subsided, the Alabama, the Vermont, the Virginia and the New York. Any two of these could have performed twice the service that has been required of them all put together. And so far, we have been quite as unfortunate with steamers. The old Fulton got as far once, we believe, as Sandy Hook; she put back, and laid at the navy yard wharf for years, until she was accidently blown up. Her modern namesake is an egregious failure, is not seaworthy, and will never repay the navy or the country for the consumption of one day's fuel. The Mississippi has proved too expensive, and has shown the country that "it costs more than it comes to," by a long shot, to keep her at sea; therefore, she has been put out of commission and laid up. The Missouri, after the same order, has been made the subject of the most silly experiments. She also will teach a similar lesson—that large steamers, like large ships, are not the thing. We have no colonies abroad at which we can found naval stations, and erect depots and magazines for the safety in war of our man of war steamers on the other side of the globe. If we have them never so large, they must always turn homeward for fuel in war. This being the case, we want small ones rather than large. The cost and expense of the Mississippi and Missouri would build and keep in commission some ten or a dozen small ones, of three or four hundred tons each. In peace, each one of these would answer all our purposes quite as well as the largest; and in war, all of them together would be much more efficient and desirable than the two large ones. But in expressing our preference for small steamers over large ones, we wish distinctly to put in a *caveat* against those who have been tinkering with the Missouri having anything to do with hull, engines, boilers, furnaces, or smoke pipes of the one about to be built. Being of iron, too, it is an experiment; therefore, we repeat, *poco a poco caballeros.* Do not let the navy bleed to death with experiments. Let her be of the smallest class of war steamers, so if there should be a failure about her, or any great mistake, or any room for improvement, or any new discoveries which may injure her usefulness or render her unserviceable, let the loss fall lightly, where losses have been so frequent and so heavy—as Jack would say, "ease them off handsomely." Economy is the word now. It is the only thing, and that, too, of the most rigid kind, that can save the navy. As good citizens, as friends of the navy, we go for it; and whatever is at variance with it—henceforth, whatever is wasteful or extravagant in naval expenditures, it shall be our highest duty to expose and rebuke.

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BOSTON AND FITCHBURGH RAILROAD.

The *fifth* important line of railroads, radiating from Boston, it will be

seen by the following notice, is in course of rapid construction. Thus it is that the Atlantic cities except New York, are all pushing forward important lines of railroad—opening easy and rapid modes of communication with the interior and with other cities, by which they can compete successfully with New York in supplying the country with merchandize, and at the same time interrupt our usual supply of produce; and if we are not more enterprizing we shall have to send to Boston for our supply of milk, butter, eggs, etc., as we have already for pork, which can be done in a year or two with great ease, or as soon as the *Long Island* railroad shall be completed, which we believe is now in a fair way to be accomplished.

Boston has her railroad to *Providence* in Rhode Island; to *Albany* in New York; to *Concord* in New Hampshire, and to *Portland* in Maine; and now she is pushing *for Burlington* in Vermont; and will reach there, too, in less than five years. And adopting the policy of "low fares," by which they are sure to attract the business and travel from a vast extent of the most populous and enterprizing portion of the Union.

Philadelphia, too, has her Columbia railroad and canals to Pittsburg; the Camden and Amboy road, and connection with the road from Trenton to New Brunswick and New York; the railroad to Wilmington and Baltimore; her Germantown and Norristown railroad; and last—but by *no means* least important—her *Reading* and *Pottsville* railroad: besides her numerous canals, by which she is supplied with the necessaries and the luxuries of life at all times, and at rates more in accordance with the times than in New York; and she can, also, and *will* furnish large supplies to the interior, which would be sought for in New York, if her citizens were as well accommodated with numerous and rapid modes of communication. So also with Baltimore, with less than a third of our population, but *double* our far-seeing enterprize and public spirit, she has *four* important lines of road in as many different directions, all now in successful operation. The distance now from Baltimore to Philadelphia is only 6½ to 7 hours; whereas a few years ago it was by no means *certain* how long. 'Tis true, on this road, they hold to the absurd high rate of fare, $4, which should be *at once* reduced to $3, or even to $2 50.

The Susquehanna railroad, connecting Baltimore with the *Garden* of Pennsylvania, and opening a direct communication with Pittsburg and the *far west*, is an evidence of her enterprize; and it is to be hoped that it may richly repay those who have invested their capital in it.

The railroad to Washington as well as that to Philadelphia, were matters of *course*—works *not* to be avoided in this go-a-head age—yet the people of Baltimore are nevertheless entitled to great credit for constructing so good a road as that to Washington, at a period when engaged in so many other important works of great magnitude. But the *eminently great* work, undertaken by Baltimorean enterprize, and at a period, too, when the capacity and importance of railroads was but little understood, is the *Baltimore and Ohio* railroad, designed to open a direct and rapid intercourse with the

vallies of the *Ohio, Mississippi* and the *great west*; a work which will insure a rapid advancement, and prosperity commensurate with the boldness of the undertaking and the indomitable perseverance with which it has been prosecuted more than half the distance, and into the immediate vicinity of a vast coal and iron region.

Thus have *Baltimore, Philadelphia and Boston* shaken hands with the *people* in all directions, invited them *to dinner* and treated them to the delicacies of their extensive markets—who will of course reciprocate their civilities and send them milk, butter, eggs and bacon in return. While *New York*, the great *natural* depot for the *eggs, milk* and *notions* of the whole country is resting upon her *laurels!* in having 14 miles of *Harlem* railroad, 45 miles of *Long Island* railroad, 53 miles of *New York and Erie* railroad and the privilege of *using* the *New Jersey* railroads!!!

*Fitchburgh Railroad.*—This excellent project, which connects with the Fresh Pond railroad, starting from Charlestown, is one of those railroads in the State which have asked for no assistance from the legislature, but has been commenced and carried on by the might of its own energy and enterprize. It is now in a condition of great forwardness, and, and will soon be finished. The subscriptions to the capital stock have reached $660,000. The road will pass through Somerville, Cambridge, Watertown, Waltham, Concord, Groton and Lancaster to Fitchburgh; and eventually to Keene, southern Vermont and lake Champlain. The first 27½ miles, extending from Fresh Pond to Groton, have been contracted for by Messrs. Belknap, Gilmore and Co., who built the railroad from Portsmouth to Portland. Seven hundred laborers are now engaged on the line. Five hundred tons of iron have been ordered by the Acadia, and the line will be opened to Waltham in September, in about four months after commencing operations.

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LOCOMOTIVE ENGINES OF 1843, IN COMPARISON WITH THOSE OF 1829.

It is probably distinctly recollected by our readers that the Liverpool and Manchester railroad company, in April, 1829, offered five hundred pounds sterling for a locomotive engine, not to exceed six tons in weight, which should haul *twenty* tons on a *level road ten miles an hour;* and an engine of this capacity was then *unknown* in the world. Fifteen years, however, have made astonishing changes; locomotives are now in common use which will haul over 500 tons on a level road ten miles an hour. At that period, 30 feet rise to the mile was considered a serious obstacle, but now 70 to 85 feet rise to the mile is easily overcome with heavy trains, and with passenger trains at a speed of 15 to 18 miles an hour. The following statement of the performance of the "MONOCACY" engine, built by the Newcastle Manufacturing company, at Newcastle, Delaware, under the direction of *Andrew C. Gray, Esq.*, exhibits an improvement in railroad machinery truly astonishing, and commends highly to railroad companies the engines of that establishment.

***Statement of the performance of the "Monocacy" Engine with a train of one hundred loaded coal cars on the Philadelphia, Reading and Pottsville railroad.—April 28th, 1843.***

The above engine left Pottsville at 6¼ A. M., and passing six coal, passenger and freight trains on the road, arrived at the Falls of Schuylkill, 88 miles from Pottsville, and 6 from Richmond, at 6 P. M.

The time actually consumed in *running*, was 6 hours and 50 minutes; or at the rate of 12 9/10 miles per hour the whole distance. The train was taken up the forty-three feet grade at the Falls in two drafts, assisted by another engine, and reached Richmond, 94 miles from Pottsville, at 7¾ the same evening.

Nett weight of coal, 335 tons; of cars, 205 tons; making the gross weight of train, not including engine and tender, 540 tons of 2240 lbs. Whole length of train, 1250 feet; amount of freight on coal, 8498.

The above train was fully within the power of the engine; the latter working with great ease during the whole trip.

The Monocacy is an eight wheel engine, built by the Newcastle Manufacturing company, Newcastle, Delaware.

Whole weight of engine, in running order, with water and fuel, 13 6/10 tons —do., on 4 drivers, 8 102/100 tons—cylinders 12 by 19 inches.

G. A. Nicolls, *Supt. Transportation.*

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STEELED JOURNALS AND CHILLED BOXES.

When on a recent visit to Newcastle, Delaware, a few days since, we learned that the use of steeled journals and chilled boxes in railroad machinery has effected a more important change in the economy, of the few roads which have as yet adopted them, than is generally known. When well made and properly used, the chilled box and steeled journal axles for passenger or freight cars, are decidedly preferable to any other form of journal or box. They combine strength, entire security, freedom from friction and cutting, and durability to such an extent, that on the roads where they are used, nothing better is hoped or looked for. Not a drop of oil is necessary. a pound or two of palm oil mixed with tallow will be sufficient for an eight wheel car for months.

On the Newcastle and Frenchtown railroad, where they have used the same chilled wheels, steel journals, and chilled boxes for *six* years, a recent inspection of them has shown them to be now as good and perfect as they were on the day they were first placed under the cars. The large eight wheeled freight cars on that road have been running every day since the 20th March last, and have not cost one cent for unguents of any kind, and the determination of the agent of that road, is to run the same cars until the winter, without additional oil or grease. An instance of one of these journals and boxes fracturing on this road has not been known. On the Charleston and Hamburg railroad, in South Carolina, the same description of boxes and journals, as we are informed, are used with equally satisfactory results.

Captain Robert H. Barr, the agent and superintendant of the Newcastle and Frenchtown railroad, has in his possession some interesting facts in reference to the use of these articles which were promised us for publication, and he will be willing at all times, we dare say, to communicate the results of his experience to those interested in the management of railroads.

We were also shown a wheel on one of the freight cars, cast with a wrought iron ring in the rim, which was broken by accident, and yet it has been in *constant use* for several years, and apparantly as safe as any other wheel in the train. This illustrates very clearly the value of wheels cast with the wrought iron ring in the rim, and we would recommend those railroad companies, who have never used these very important improvements, to adopt them, and to send to A. C. Gray, Esq., for information in relation to them, as well as for the work when wanted, as we have good reason to believe that it is to be relied on in all respects.

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### PROGRESS OF RAILROADS IN EUROPE.

We give in this number, from the London Morning Chronicle, an interesting account of the progress of railroads in Germany. The Emperor of Russia is also pushing forward his great work from *St. Petersburg* to *Moscow*, and *designs*, we doubt not, to continue it to the shore of the Caspian sea. He has drawn into his service able engineers, machinists and mechanics, from *this*, and we presume also from *other* countries; and has large orders for machinery in course of execution, now, both in Philadelphia and Baltimore, which are to go out this season. Indeed, but for the *foreign* orders for locomotives, excavators and other machinery, many of our industrious mechanics would be now without imployment.

We understand that Major Whistler, who has charge of the railroad, is highly esteemed by those in whose service he is now engaged; and also that Mr. Joseph Harrison, of Philadelphia, and Mr. Thomas Winans, son of Ross Winans, Esq., of Baltimore, both of whom have gone out to superintend the erection of large machine shops, under the patronage, and at the expense of the government, are well satisfied with the reception they have met with.

Thus it will be seen that the *monarchical* governments of Europe duly appreciate the vast importance of railroads as a means of controlling the people; but if we are not mistaken, *railroads* are the precursors of *liberty* and *equlity* to the *people* everywhere. *Intelligence* leads directly to liberty and equality, and railroads cause the "*schoolmaster to be abroad.*"

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### MISSING NUMBERS OF THE JOURNAL.

If any subscriber to the Journal desires to supply missing numbers to any volume since July, 1838, they are requested to give *early* notice, that they may, if possible, be supplied now when we have some odd and surplus numbers on hand.

EXTRAORDINARY PHENOMENON.

A singular discovery was recently made in the office of the RAILROAD JOURNAL and Mechanics Magazine, when its former editor and founder returned to his old station, after a long disconnection from it. On looking about the office he discovered that one very important book, the *Ledger*, was out of its place. It was replaced on the shelf, where it belongs, but, singular as it may appear, whenever he returned to the office, after a short absence, the Ledger was out of its place, which induced an investigation into the cause of the occurrence. After dilligent search, and due deliberation, we were led to the conclusion that this singular phenomenon—*if it is* singular in publishing offices—can only be accounted for in the following way. On turning over the leaves, he discovered that on *one* side of the page there were numerous entries, thus—A. B., *Dr.* £1—C. D., *Dr.* £2—and E. F., £3—and so on through the alphabet; whereas, in very many cases—*quite too many* for the interest of the editors—there was *no corresponding* entry on the *opposite* side, and on adding up the two columns, he found a difference of £500 or £600 in (the weight of) the two sides of the Ledger; thus accounting, in a very *natural* way, for the uneasiness of the—*Editors*, if not of the—Ledger. We shall be gratified to learn if any similar occurrence, from *like cause*, has ever been heard of. If there has been a *solitary* instance, it should be put on record for the benefit of future historians. And it is not, for a moment, doubted but that those, opposite to whose names these *blanks* occur, will *immediately* have them filled, so as to enable us to determine the cause of so singular an occurrence; and we would suggest the propriety of an experiment by which the ballance may be thrown on the *other side*, that we may be able to ascertain whether it will cause a similar tendency in the book to be out of place. Should it, fortunately for the Journal, for *once* get on the *other* side, and produce a similar propensity in the book, we will go security that the *Editors* will never complain—though, as in duty bound, they will certainly record a phenomenon so singular.

☞ And now, my dear sir, we ask your hearty co-operation in the good cause. We ask you to recommend the RAILROAD JOURNAL to others, as well as to take it yourself, and to remit the amount of their subscription with your own. We think it should be taken by Stockholders generally, and especially by Railroad Companies—several copies for each, to distribute among those in their employ—and that Railroad Companies should Advertise on its cover, that it may be sought for by travellers and others, and thus diffuse more generally, correct information in relation to the character of Railroad Stocks as an investment. If the different Railroad Companies in the United States would take five or ten copies each, and advertise their rates of fare, at $10 a year, the circulation of the Journal would soon reach 5 or 6,000 copies, and be the means of disseminating widely, information exhibiting the success of railroads in this country and in Europe, which now seldom reaches the people. And it is for the interest of every Road, and every Stockholder, and every Engineer, to have the subject better understood. We therefore request you to give us the benefit of your influence in extending the circulation of the Journal, and we pledge ourselves to labor diligently in the cause.

The EDITORS.

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By GEO. C. SCHAEFFER, and D. K. MINOR.

AMERICAN

# RAILROAD JOURNAL,

AND

# MECHANICS' MAGAZINE.

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The South Carolina canal and railroad company being hereafter merged in the Louisville, Charleston and Cincinnati railroad company, the present report is intended to give a general view of the affairs from the first organization of the corporation. A highly interesting history of the undertaking we have already extracted in a previous number.

This report by Mr. Tristram Tupper, late President, shows that great advances have been made in economy and good management, and throughout the zeal and faithfulness of this gentleman to his duties are well displayed.

But while admiring the industry with which the materials of the report have been collected we cannot but regret that the truth of certain statements in the preface had not been more fully investigated before publication. In endeavoring to exalt the value of the stock passing into the hands of the Louisville Cincinnati and Charleston railroad company, Mr. Tupper takes the opportunity of stating that the stocks of but *four* railroads in the United States are above par, while all others are *at*, or far below par. The statement is not only literally untrue, but is calculated to produce a bad effect upon this species of investment. We have no doubt that such a result was far from the mind of the writer, but still he should have been careful not to decry all other works in praising his own.

REPORT.

*To the Stockholders of the South Carolina Canal and Railroad Company:*

In accordance with the general usage of this company, and in conformity with one of its rules, a statement of its affairs, as made up by the secretary and treasurer, is herewith presented, showing the gross income of the half year, ending the 31st December, 1842, to be $182,678 05

And the expenditure for the same time, for improvement and repairs, 110,085 22

Leaving a nett income of $72,592 83

Being over the rate of 7¼ per cent on the capital of $2,000,000; and showing a gain over the same months of last year, $28,519 89

In larger receipts, $18,929 22

And smaller expenditure, 9,590 67

This encouraging result has been presented in each of our semi-annual reports for the last three half years, exhibiting a gradual improvement in the

condition of the company; and it will be our duty to show in the present report, how our contracts and engagements might have been made to produce the company a much larger nett income, without materially affecting its general arrangements.

Since the 1st of July, the company have reduced its indebtedness $72,592 83.

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| From amount then due, | $212,675 88 |
| To amount now due, | 140,083 05 |

The only remaining debt of the company, (except for incidental expenses for which we have cash in hand,) is $100,000 to the State of South Carolina, with interest, $53,253, payable in 1847.

The accounts thus show a surplus of over $13,000, from which a dividend might be safely made of one-half per cent., but we believe it more advisable to retain it until July, when a full dividend of at least 3½ per cent. can be made.

Since the 30th June, 1839, the balance due by this company, over its assets, have been reduced from the nett income, $355,121 57

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| The amount at that time, | $495,159 62 |
| And at this time, | 140,038 05 |

embracing the amount borrowed from the Louisville, Cincinnati and Charleston railroad company, to complete the improvements of our road to that date, $332,182 10

With interest since credited, 39,914 14

Making amount paid that company in full, $372,096 24

This fund would have paid dividends to the amount of 18 4/5 per cent., if not applied to the payment of debts, or about 5⅓ per cent. per annum, during a period of the most depressed state of trade, perhaps ever known.

And whatever may be the state of trade for the future, it is believed that the low amount to which the expenses of our road is reduced, (compared with former years,) will enable it to produce a handsome profit to the stockholders.

In my July report, it was stated that "the current half year will, no doubt, on both roads, furnish a nett income of not far from $100,000." It appears that the amount realized is $101,600 37. It was also stated, that at least 60 setts of chilled wheels and axles, with steel journals and chilled boxes, would be made in the work shops during the ensuing six months, and that the platform cars would be increased to 30 on eight wheels—63 setts of the wheels have been cast and fitted to axles, and the 30 platform cars completed, which aid much in the transportation of cotton.

The report of the superintendant of the road, (Mr. Lythgoe,) will show the progress and improvement of his department—and by the contracts he has made for the ensuing year, the amount of wages will be further reduced, notwithstanding there has been to this time a gradual reduction for the last six years in this item of our expenses.

There is strong reason to believe that the effort made to preserve the timber for repairing the road, by Earleizing it, will contribute much in lessening the consumption of this article, which is now less than half the amount used four years ago.

About four miles of road, at different points, have been laid with this prepared timber, besides several turnouts, without any additional expense in the road department; as we stated in our last report, the inferior sap-timber used is obtained for enough less than the heart-timber, to defray the expense of Earleizing—and so soon as the test going on in Sixth street, Philadelphia, (of inferior hemlock laid down in 1839,) is rendered sufficiently satisfactory

to warrant it, the whole road could be relaid with mineralized timber as fast as that now in the road is required to be removed, which may be done with diminished expenditure each successive year.

The report of the master of machinery shows the condition of that department, and the progress of improvement there; the economy in the work shops, for the last two years, is particularly interesting, and should be very gratifying to all who have a knowledge of it. We have in many things surpassed all similar establishments; our success in making such machinery as is required, particularly wheels, axles and boxes, and preserving them from wear while running, has exceeded all precedent, and will be a saving to the company of at least twenty thousand dollars per year in the machinery department.

Since the 1st of July, we have had cast 254 chilled wheels of the same quality commenced twenty-two months since, of which not one has yet failed, which, with the axles, having steeled journals, and chilled boxes, cost but one-half the price of any ever obtained from abroad; these are also used in the place of, and are much more durable than the wheels with wrought iron tires fitted with brass boxes, which have cost more than four times as much as these made here, of *condemned materials.* Their being fitted for the use of tallow, instead of oil, is a saving of nearly the whole cost of the latter, which, when used on the train, was applied every ten miles run, while with the new arrangement, where the boxes are well fitted, (after the first few trips, which wear the parts smooth,) there is little or no consumption of the tallow. In fact, the passenger trains, which have been particularly watched to ascertain the result, have not consumed as large an amount in tallow in twelve months as formerlly was applied in oil in two trips. Oil is now only used in the work shops, and on such parts of the engines and cars as are not fitted for tallow.

The cost of oil and tallow purchased annually has been reduced from $6,500 worth in 1837 to $2,000 in the last year, and the number of trips much increased since the former period.

The engines built in our shops are more simply constructed, and consequently require less repairs than any we have had from Europe or the northern States. There is one now nearly finished, which, it is believed, will be capable of a greater performance than any one now on the road.

The position of our shops has given the master of machinery a greater opportunity to improve upon the locomotive engine, than perhaps any other machinist. Having been at the end of one of the longest roads a greater length of time, where he has seen every engine go out and come in, and obliged to correct their defects, and cannot have avoided discovering any disproportion of their parts, or any unsuitableness of the materials used in their construction, and must have acquired the best mode of adjusting and renewing these imperfections.

These views will be fully confirmed by reference to the general statement, showing the expenditure for the last seven years, where it will be seen that the annual cost of machinery and materials have been reduced since 1837 from about $90,000 in that year to $22,250

A saving in this department of $67,750

with only $6,000 increase of the work shop wages, when it must be recollected that the former year commenced with as great a number of engines as the last.

The extent of our work shops, although the buildings are inferior, and the perfection of the preparations there for carrying on the work, is producing an immense saving to the company, and these works are daily improv-

ing by setting up additional apparatus and machinery for facilitating the business of building and repairing engines and cars.

This economy has gone through the whole business of the company, as will be seen by the same general statement.

The aggregate of all the items of expenditure, except land, new iron and embankment, in the year 1837, was about $377,000
and the same items in 1842, 225,700
Showing this difference $151,300
in favor of the last year, with nearly double the business on the road.

This will be more satisfactorily explained by another statement, giving the cost of the miles run each year.

In 1837, 172,456 miles—$377,148 54 expenditure; $2 12½ cost per mile.

In 1842, 299,744 miles—$225,742 62 expenditure; 72 cents cost per mile.

It is proper here to admit that this great difference is not all obtained by economy, a considerable part of it is from the fact that many of the articles used are now purchased at a much lower price than formerly, and some part of the outlay in 1837, was for improvements not requiring to be repeated each year. These we will assume would have amounted to $50,000, or one-third the difference stated above. Such is the present condition of the property belonging to the South Carolina canal and railroad company, that it is now fully worth its cost to the Louisville, Cincinnati and Charleston railroad company, $125 per share, and including interest since purchased, $150 per share—and by allowing the purchasers of the stock to assume the debts of the Louisville Cincinnati and Charleston railroad company in part payment, for which this stock is liable, believe it might be disposed of at the above rate—or the whole property in the name of the South Carolina canal and roailroad company might be leased or "farmed out," agreeably to the provisions in the charter, (by giving all its privileges,) at the rate of ten per cent. per annum on the capital of two millions, for ten years, payable monthly in advance. The property to be preserved in its present good condition, and the transportation on the Columbia road, performed and charged at the same rate per mile that it should cost on the main road. The lessee to have the right, and be required to pay the interest on the debt of the Louisville, Cincinnati and Charleston railroad company, on account of the rent, as it is required by an act of the legislature, that the interest on the Sterling bonds be paid from the income of the South Carolina canal and railroad company.

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More than a year since our attention was excited by the excavating machine employed at Fort Green, Brooklyn. We paid it several visits, and were highly gratified with its performance, but from not knowing who the proprietors were, we were unable to afford any satisfactory information as to the details of the machinery, or the cost of operating it. We at last found a very good and tolerably complete notice which was published in the number for March, 1842, p. 177.

The following description, together with an account of previous patents, for similar purposes, is from the London Journal of Arts and Sciences. We are indebted to Messrs. Eastwick & Harrison for the English cut which accompanied this article.

It must be recollected that this is the first excavating machine which has

ever gone into successful operation—in this country at least. Much interest is felt in it, and we have heard many inquiries in regard to the cost of working, and the circumstances of ground favorable for its use. From the want of notice on the part of the proprietors, we have never succeeded in obtaining this, though we have at times taken much pains to gather the desired information. Their own advantage should prompt them to give publicity to everything concerning the machine.

MACHINERY FOR EXCAVATING, OR CUTTING, AND REMOVING EARTH.

Many have been the attempts to supersede, by means of machinery, the use of hand labor in the tedious and laborious operations of cutting and removing earth, for leveling inequalities of the surface, forming canals and docks, and clearing the beds of rivers. These mechanical contrivances have necessarily partaken of the same general features, viz., moving peckers and shovels, or scoops, constructed and arranged in various ways, and actuated by wheels and levers, in a variety of forms and combinations, from the simple and well known dredging apparatus, commonly worked in our harbors and rivers, to the elaborate and gigantic new American excavator, which, under the absurd cognomen of the "Yankee Geologist," has been proclaimed to the world as capable of removing mountains.

Without intending, in the slightest degree, to detract from the merits of this American invention, which we hear from disinterested parties, who have witnessed its performance, to be one of paramount importance and vast capability, we think it necessary, in order to qualify the extravagant statements given in some of the periodicals of the day, both foreign and English, respecting its astonishing powers, to state what are the leading points on which its claims to novelty are founded.

In order to show this more clearly, it will be desirable to mention, in a brief way, the objects and features of the several machines for excavating and removing earth, which have been the subjects of patents within the last twenty years. The first of these we find to be the invention of George V. Palmer, of Worcester—a machine to cut and excavate earth, granted 8th June, 1830. This machine is mounted upon wheels, intended to advance upon a temporary railway, laid upon the surface where the excavation is to be made, beneath which a hole is dug to commence the operations in. There are a number of peckers in front of the machine, which by vibratory action, dig into, and thereby break up the earth. A consecutive series of buckets, connected by an endless chain, are brought down into the disturbed and broken ground, and scrape up the soil, stones, etc., which are carried away up an inclined plane, in the manner of the ordinary dredging apparatus. The machinery is worked by a winch and toothed gear, and advances upon its railway as the earth is broken and removed.—See vol. vii, page 314, of our second series.

Mr. G. V. Palmer, of Worcester, had a second patent granted, 24th January, 1832, for improvements in machinery or apparatus for excavating, and which he called an excavating and self-loading cart. This contrivance much resembled an ordinary cart upon two wheels, drawn by horses. Under the cart were placed the cutting, or excavating, instruments, formed something like the share and breast of a plough, which excavators were capable of being lowered, so as to take into the ground and break up the soil to any required depth, as it advanced; or they might be drawn up out of operation, in order to allow of the cart travelling on ordinary roads, when proceeding to, or returning from, its work. The running wheels of the cart were broad,

and their felloes hollow, and in these hollows were transverse partitions, formed by plates, which constituted the bucket wheels. On the cart advancing, the ploughs, or cutters, penetrated into and broke up the ground, and turned the soil sideways into the buckets of the running wheels, which, as they revolved, raised the soil, and, in turning over, let it fall on to inclined edges, by which it was conducted into the cart.—See vol. i, page 278, conjoined series.

In December, 1833, a patent was granted to Mr. Thos. Affleck, of Dumfries, for his invention of improvements in the means and machinery for deepening and excavating the beds of rivers, removing sand banks, bars and other obstructions to navigation. This, however, consisted merely of apparatus, which, when agitated by the rolling waves, or rise and fall of rivers, disturbed and broke up the mud, sand or gravel, for the purpose of enabling it to be washed away by strong currents, or freshets.—See vol. iv, page 273, conjoined series.

An apparatus to facilitate and improve the excavation of ground, and the formation of embankments, invented by Mr. William Brunton, engineer, of London, was made the subject of a patent, dated 2d November, 1838. A part of this invention was a series of hook-shaped cutters, fixed in a frame, one in advance of another, and which, being connected to machinery, were forcibly projected into the ground, and made to plough it up in grooves; each cutter, as it advanced, cutting and preparing the way for the next cutter in succession. The other parts of the invention applied to the arrangement of stages, and the order in which a series of workmen were to dig and remove the soil. Also, the manner of depositing soil for the formation of embankments; compressing it to give solidity; and conducting the earth-wagons, upon tram-ways, by endless ropes.—See vol. xvii, p. 284, conjoined series.

Mons. L. J. A. Ramel, a foreigner, obtained a patent in England, dated 19th March, 1838, for his invention of improvements in machinery for excavating and embanking earth, for the construction of railways, and other works. The specification of this patent does not set out in very clear terms what are the features of novelty proposed, but speaks of the "system of a lever." As far as we can understand the subject, it seems to be merely the adaptation of a long lever as a crane, which works vertically, to raise loads of earth in a box, in place of employing hand barrows, passing up inclined planes, or of pitching the earth from stage to stage by hand-labor. This lever is mounted upon a platform, with running wheels, for the convenience of passing it from place to place, upon a railway; and the lever, to one end of which the loaded box is attached, is worked by a cord, or chain, connected to the other end, and to a winding drum, or barrel, and windlass; and when the load of soil is conducted to the place of deposite, it is let fall into a cart, by opening the bottom of the box.

An invention of certain improved machinery for cutting and removing earth, was communicated to Mr. William Newton, of Chancery Lane, by a foreigner, for the purpose of obtaining a patent, which was granted on the 27th March, 1839. This invention is a peculiar arrangement and construction of apparatus, mounted in a carriage upon a temporary railway, in which a series of rotary cutters, or peckers, working in inclined positions, are made to break the ground below, at an angle of about forty-five degrees, as the carriage proceeds; and also to throw the earth, thus broken, into a consecutive series of buckets, attached to an endless chain, which, by travelling vertically, takes up the broken earth to the top of the excavation, and delivers it into a series of troughs above, which troughs, by moving in a transverse

direction, carry away the earth and deposite it in carts, or otherwise, as convenience may require.—See vol. xvi, page 57, conjoined series.

Mr. W. Scamp, of Woolwich, obtained a patent, dated February, 1841, for an application of machinery to steam vessels, for the removal of sand, mud, soil and other matters, from the sea, rivers, docks, harbors and other bodies of water. This invention consists merely of a barrel, studded all over with spikes, which, being mounted upon an axle, was suspended by lever arms from the vessel, and, on being lowered down to the bed, or bottom of the river, the barrel was made to revolve, as the vessel advanced, by a travelling endless chain, extending from a pulley, or spur wheel, on the axle of the propelling wheels; or, by other rotary means, to a pulley on the axle of the barrel, so as to cause the mud, sand, and other materials on the bottom, to be disturbed, or broken up, by the spikes, and on mixing with the water, to be carried away by the current.

These are all the schemes which have been proposed and brought before the public, under the protection of letters patent in England, within the last twenty years, until the introduction of the American invention above alluded to.

This machine, which we are not permitted at present to lay before our readers in all its details, consists of a horizontal platform, mounted upon wheels, carrying a strong jib-crane, and also a steam engine. From the end of this jib-crane, the excavating tool, or cutter, is suspended by chains and pulleys, which allow of its swinging in a forward direction; and the back part of the tool, or cutter, is attached to a rod, or beam, sliding on rollers, which being acted upon by chains and toothed wheels, in communication with the steam engine, causes the cutter to be projected, with great force, against the earth required to be broken up.

The mechanism and the suspending chains, connected with the steam engine, and with the projecting rod, or beam, affords the means of regulating and determining the course in which the cutting tool shall move forward; and by means of a small hand lever, a workman, standing upon the platform, is enabled to direct the advancing cutter through the ground, in a horizontal line, or through any inclined or curved course, up to a perpendicular; the movements of the pendulous chains determining the course of the cutter, while the sliding beam projects it forward.

The excavating tool is formed as a scoop, with strong tangs, or teeth, in front, to break the earth as it enters, and a sharp cutting edge to take up the broken fragments.

The machine having been moved upon its railway to the place where it is required to excavate, the platform is then made fast, pro tem., in that situation, and the steam power of the engine brought to act upon the mechanism, by sliding clutches, or other contrivances. The pendant tool, or excavator, is then forced forward by chains, connected to the projecting beam, and passed round a rotary drum, driven by gear from the engine; and at the same time, the pendant chain is drawn up, or let out, as may be necessary, to allow the excavator to advance in the required course. When the projecting beam has carried the excavating tool forward to its extent of action, in a horizontal cut, the suspending chain, from the crane-jib, will raise the loaded scoop, (or the projecting and raising of the scoop may be simultaneous, as the workmen shall direct,) which loaded scoop when brought to its highest position, may be conducted to one side of the excavation by the swinging jib, and the contents let fall into a cart, by opening the back of the scoop; all which operations are effected through the agency and power of the steam engine, under the direction and regulating hand of the workman.

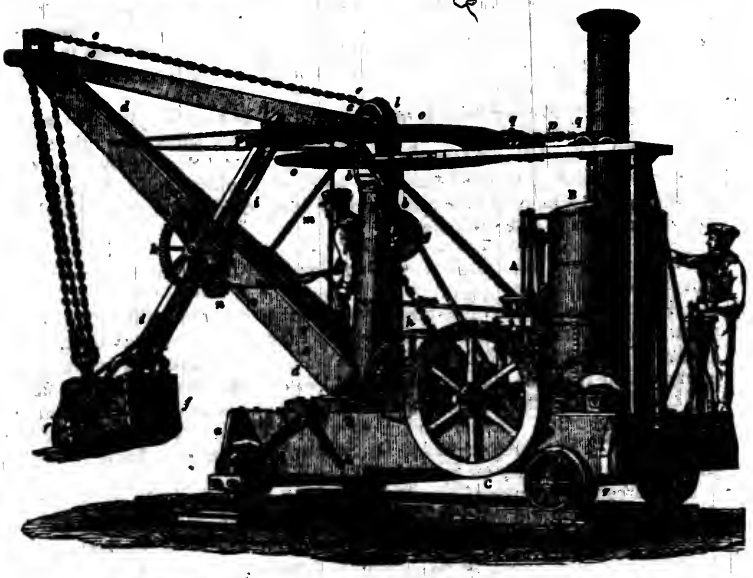
It is only necessary further to say, that by turning the jib of the crane to the right or left, the cutting of the earth may be performed at any angle to the direction of the machine, and, consequently, to a very considerable extent—viz., a circuit of forty or fifty feet—without shifting its situation; but when a change of place becomes necessary, the fastenings by which the platform was secured must be withdrawn, and the power of the steam applied to move the whole, upon its turning wheels, to the next place where it may be required to be made stationary.

Having given this brief description of the construction and mode of working the new American excavating machine, we conclude our present report by stating the points of novelty which it may fairly claim over others that have preceded it. Firstly, it is locomotive; its movements, and all its operative parts, deriving their powers from the steam engine which it carries. Secondly, that the earth is broken up and carried away from the place excavated by one instrument, (the scoop,) acting with immense effect, through the power and agency of steam. Thirdly, that the cutting may be made with equal facility at any inclination to the horizon, and to a great extent around the spot on which it is stationed, by the direction of the workman, without requiring to be moved from its place. Fourthly, that, by this machine, a channel may be cut through a hill, with the proper slopes for its sides, and a level base correctly formed, the excavated earth being simultaneously removed. Fifthly, the capability of cutting many feet below the base on which the machine runs, by lengthening its chains and guide-beam; which last feature renders it also applicable to working under water, when placed in a vessel, for removing sand banks, bars and beds of mud.

The engine and boiler, by which the various parts of the machine are put in operation, are shown at A B—*a a* is the framework, provided with wheels, by means of which the whole apparatus is capable of being moved along a temporary railway, as the machine digs away and removes the earth before it. The crane-post is shown at *b b*, at the upper end of which is placed the crane-jib *c c*, supported by the diagonal beam *d d*, which is also used for carrying certain wheel work and apparatus for effecting the required movements of the shovel. At each end of the crane are mounted pullies, over which a chain *e e*, passes from the shovel, or excavator *f*, and from thence down the centre of the crane-post, and under the carrier-pulley *g*, to a windlass, or capstan, on the axis of which is mounted a large toothed wheel *h*, taking into a pinion upon the main driving-shaft, on which is mounted the fly-wheel c. The shovel, or excavator, is connected by swing-joints to the forked end of diagonal arms *i i*, which are furnished with chains, attached to each end thereof. These chains pass once round pullies, mounted upon the axle of the toothed wheel *k*; and hence, on rotary motion being communicated to the said axle, the diagonal arms *i i*, and consequently the shovel *f*, will be caused to move upwards or downwards. The end of the shovel is connected by hinges to the other parts thereof, and retained in its proper position, during the operation of digging, by means of a bolt, or pin, which may be withdrawn, by means of suitable apparatus, when the filled shovel is raised by the chain *e e*, and swung round to the required position; the shovel will then tilt over, depositing the excavated earth in a wagon, or other required receptacle.

Upon the axle of the guide-pulley, on the top of the crane-post, is a beveled toothed wheel *l*, taking into a similar wheel, mounted upon a diagonal shaft *m*, at the lower end of which is a beveled pinion, taking into another, mounted upon the axle of a pinion *n*, which latter pinion is capable, by means of hand-levers, of being shifted in and out of geer with the wheel *k*; by

which arrangement, the chain *e*, passing over the guide-pulley, and communicating rotary motion thereto, will cause the pinion *l*, and shaft *m*, to revolve, and thereby, through the intervention of the pinion *n*, and wheel *k*, effect the required motion of the diagonal arms *i i*, and shovel *f*, the attendant being able to arrest the motion thereof, at any time, by means of the hand-levers connected to the pinion *n*.



The horizontal motion, or swinging round, of the crane is effected by means of the horse-shoe shaped pulley *o o*, affixed to the crane by cross-rods; to this pulley each end of a chain *p p*, is fastened, which chain, having passed round the periphery thereof, is conducted downwards, by means of guide-pullies, *q q*, passing once around an axle, driven by wheel-work, connected to the engine, which wheel-work is capable of being shifted in and out of gear with the main shaft, by the attendant, through the intervention of a hand-lever; by this arrangement, the chain *p p*, is put into motion at discretion, thereby causing the horse-shoe pulley *o o*, to revolve, and with it, the crane and shovel, or excavator. The machine is propelled along its temporary railway, as the work progresses, by means of a toothed wheel *r*, affixed on the axle of one pair of running-wheels, and connected to the motion of the engine by suitable gearing.

When the operation of excavation commences, the shovel is caused, (by the loosening of the chain *e e*,) to assume a nearly perpendicular position, the teeth thereof being turned towards the earth; motion then being communicated to the several parts, by means of their respective trains of wheel-work, the chain *e e* is gradually drawn tight, and wound around the capstan or windlass; during which operation the arms *i i* are brought into action, forcing the shovel into the ground by the means before described; hence it will be perceived that the shovel, or excavator, is operated upon by power exerted in two directions, the one through the medium of the arms *i i*, caus-

ing it to be thrust into the earth, the other through the medium of the chain *e e*, and its appendages, causing it to be lifted therefrom; by which combined action, and suitable speeds of driving gear, the shovel will describe a curve in ascending, the commencement thereof, being just in front of the machine, and the end thereof vertically under the front of the crane-jib. The shovel being filled with earth, and raised to this point, is swung round, by means of the horse-shoe shaped pulley *o*; and the bolt, which secures the ends thereof, being withdrawn, the contents will fall into the wagon, or other required receptacle; after which, the crane is again swung round, and the various parts put out of gear, when the shovel will descend, in order to operate upon the earth as before.

This peculiar arrangement of apparatus, it will be seen, is applicable only to operations performed on land; but a machine on the same principle, suitably modified for the intended work, has been constructed for the purpose of dredging harbors, deepening rivers, or other such operations, a description of which, with a more minute account of the first machine, we shall lay before our readers at a future time.

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*Railway Speed and Safety.*—The following paragraph is from a late London paper:

"The returns given in the report of the officers of the railway department, board of trade, shows the average speed upon the various lines, exclusive of stoppage, as follows: London and Birmingham, 27 miles per hour; Great Western, 33; Northern and Eastern, 36; North Midland, 29; Midland Counties, 28; Manchester and Birmingham, 25; Newcastle and North Shields, 30; Chester and Birkenhead, 28; and Birmingham and Derby, 19. The average speed on the Metropolitan lines, exclusive of stoppages, is about 22 miles an hour.

The foregoing returns of speed on the English railways shows an average rate exceeding the rates in this country, say 19 to 20 miles per hour. On some of our best roads, with the heavy edge rails, we have accomplished as high rates of speed, to wit, a mile in a minute, as was once performed in England. Our engines have drawn larger loads up higher grades in comparison to their weight. The great difficulty with most of our roads is, that they are too slightly built, from the dificiency of capital in this country. There will be no difficulty with a good road, *and none other should be built*, between this city and Albany, in accomplishing the distance in six hours, which is only 25 miles per hour, a speed 33 per cent. less than that performed on the Northern and Eastern railroad.

Mr. Lang, in a report to the London board of trade, shows by a number of facts, "that railways are the safest of all modes of conveyance, and more particularly safe than steamboat travelling." From 1st January to 1st July 1841, only three lost their lives from causes beyond their control. The number of passengers travelling was 9,122,000. The distance travelled, 182,440,000 miles. The number killed from causes beyond control were one to 3,040,666. Only one passenger lost his life for each 60,813,333 miles travelled.

J. E. B.

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If any one of our readers can make anything out of the following announcement, we will cheerfully yield him our editorial pen and scissors, and resign.

*Revolving Steamer.*—We have unintentionally neglected to speak of a model of a vessel, that has been exposed to public inspection at the St. Charles Exchange, which has been the subject of no little speculation. The

vessel is composed of a number of air-tight boxes, connected together by hinges, which revolve over two wheels at the extremity of the boat. There are two sets of these boxes, and the engine is to be fixed between them. When the machinery is put in motion, the wheels which keep the "chain of boxes" distended revolve with rapidity, and the boxes of course pass around them. At the top of each box is a fixed paddle intended to take hold upon the water as it revolves. By this contrivance it is thought by the inventor that the vessel will be propelled with nearly the same velocity through the water as it has no water to displace by pressing through it, but roll over its surface. The revolving boxes, air tight, are in fact the vessel itself.—*New Orleans Bee.*

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*Electro-Magnetic Telegraph.*—We are gratified to state that the board of directors of the Baltimore and Ohio railroad company has given permission to Professor Morse to use the track of the Washington road for the purpose of carrying out the intentions of the act of Congress in reference to his important invention of the electro-magnetic telegraph. One station of the telegraph will be at some appropriate place in the city of Washington, and the other in the city of Baltimore, and the communication between them will be effected by properly prepared wires laid along the line of the railroad. The object of this arrangement is to prove what Professor Morse has already most satisfactorily shown on a less extended scale, that the lengh of the line of communication presents no obstacle whatever to the instant transmission of intelligence between the two extremes, either by day or night. We predict for this ardent votary of science the triumphant success that he so well merits.—*Baltimore American.*

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*Ballooning the Atlantic.*—Mr. J. Wise, the celebrated balloonist, gives notice to all the world, that he will very shortly make an ærial trip with his balloon across the Atlantic. He thus concludes his communication:

The balloon is to be 100 feet in diameter, which will give a nett ascending power of 25,000 pounds, being amply sufficient to make every thing safe and comfortable. A seaworthy boat is to be used for the car, which is to be depended on, in case the balloon should happen to fall in accomplishing the voyage. The boat would also be calculated upon in case the regular current of wind should be diverted from the course by the influence of the ocean, or through other causes. The crew to consist of three persons, viz: an Æronaut, a Navigator, and a Scientific Landsman.

Therefore, the people of Europe, Africa, Asia, and all other parts, on the ocean or elsewhere, who have never seen a balloon, will bear in mind, that it is a large globe made of cloth, ensconced in a nett work, with a sloop hanging underneath it, containing the "latest news from the United States," with the crew of the world's obedient servant. JOHN WISE.

*Lancaster, Pa., June 8th*, 1842.

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KITE'S PATENT SAFETY BEAM.

We have frequently noticed this truly valuable railroad invention. It is simple, cheap and effectual, while there is no other method of accomplishing the same end. Our attention has recently been drawn to other benefits besides safety to the traveller, which may be derived from a use of Mr. Kite's invention—we mean saving of time to the passenger, and of money to the railroad company. We have recently had some experience upon this point. On the Long Island railrond, over which we pass six times a week, a num-

ber of axles have been broken in the last six months—the cold weather of February was particularly fruitful in such accidents. On one of these occasions, the whole train was detained by the axle breaking under the tender; and before any advance could be made, the tender had to be removed and another furnished. The whole delay occupied about two hours. Now two hours for two hundred passengers, makes four hundred hours lost, or *forty days*, of ten working hours each—worth to a mere day laborer forty dollars, or enough to pay for the construction of a safety beam to every tender used on the road.

If Kite's safety beam had been used, *no delay* would have taken place, and *few, if any of the passengers would have ever known of the accident!* On several other occasions we have noticed, that the destruction of one axle involved that of several others, generally of all the wheels attached to them, and always of more or less of the track. Now the damage in each instance —leaving out of the account the injury to the cars and freight, sometimes a very serious one—would in no case be less than fifty dollars. We have thus the loss of forty or fifty dollars worth of time to the passengers, and of fifty dollars worth of damage to the company—always one or the other, and sometimes both at the same time—and all for want of this simple and economical preventive. These instances, we believe, are by no means rare on other roads; we only mention these as coming under our immediate observation. The company in question have, we understand, a few of these beams in use, and, so far as we have seen, no accident has ever happened to them; *they*, therefore, have an inducement to the employment of Mr. Kite's invention, which others have not.

Until something better can be devised, we shall continue to insist upon the necessity of employing Kite's safty beam.

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For the American Railroad Journal, and Mechanics' Magazine.

## NOTES ON PRACTICAL ENGINEERING.—NO. 1.

### *Cubical Quantities.*

It is probable that all Engineers have, at different periods of their practice, devoted much time and attention to various methods of calculating cubical quantities. Innumerable tables have been formed and some few printed, but the writer is not aware that any tables of a general character have been published, except those of Mr. E. F. Johnson.

These tables give the cubic yards for 10 feet in length of pyramids, frustrums of pyramids and triangular prisms with slopes of $\frac{1}{2}$, 1, $1\frac{1}{2}$ and 2 to 1 when the depths at the ends are known. Also the cubic yards in rectangular prisms 10 feet wide, and, as in the other solids, 10 feet long. The calculations are made for depths from ·2 to 54 feet, the common difference being ·2 and the column of depths headed D+d represents the sum of the depths at the two ends.

| D+d | Pyramids. d=o | | | | Frustrums of d=1(D+d) D=9(D+d) | | | | d=2(D+d) D=8(D+d) | | | | Pyramids. d=3(D+d) D=7(D+d) | | | | d=4(D+d) D=6(D+d) | | | | Triangular Prisms. D=d | | | | Rectangular Prisms 10 feet breadth. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | b=½D | b=D | b=1½D | b=2D | b=½D | b=D | b=1½D | b=2D | b=½D | b=D | b=1½D | b=2D | b=½D | b=D | b=1½D | b=2D | b=½D | b=D | b=1½D | b=2D | b=½D | b=D | b=1½D | b=2D | |
| Feet. | c. yds. | c. yds. | c. yds. | c. yds. | c. yds. | c. yds. | c. yds. | c. yds. | c. yds. | c. yds. | c. yds. | c. yds. | c. yds. | c. yds. | c. yds. | c. yds. | c. yds. | c. yds. | c. yds. | c. yds. | c. yds. | c. yds. | c. yds. | c. yds. | c. yds. |
| 10·0 | 3·09 | 6·17 | 9·26 | 12·35 | 2·81 | 5·61 | 8·42 | 11·23 | 2·59 | 5·18 | 7·77 | 10·36 | 2·44 | 4·87 | 7·31 | 9·75 | 2·34 | 4·69 | 7·03 | 9·37 | 2·31 | 4·63 | 6·94 | 9·25 | 18·52 |
| 10·2 | 3·21 | 6·42 | 9·63 | 12·84 | 2·92 | 5·84 | 8·76 | 11·68 | 2·69 | 5·40 | 8·09 | 10·78 | 2·54 | 5·07 | 7·61 | 10·15 | 2·44 | 4·88 | 7·32 | 9·76 | 2·41 | 4·81 | 7·22 | 9·63 | 18·89 |
| 10·4 | 3·34 | 6·67 | 10·01 | 13·35 | 3·04 | 6·07 | 9·11 | 12·15 | 2·80 | 5·61 | 8·41 | 11·21 | 2·64 | 5·27 | 7·91 | 10·55 | 2·54 | 5·07 | 7·61 | 10·15 | 2·50 | 5·01 | 7·51 | 10·01 | 19·26 |
| 10·6 | 3·47 | 6·93 | 10·40 | 13·87 | 3·15 | 6·31 | 9·46 | 12·61 | 2·91 | 5·82 | 8·73 | 11·64 | 2·74 | 5·47 | 8·21 | 10·95 | 2·63 | 5·27 | 7·90 | 10·53 | 2·60 | 5·20 | 7·80 | 10·40 | 19·63 |
| 10·8 | 3·60 | 7·20 | 10·80 | 14·40 | 3·28 | 6·55 | 9·83 | 13·11 | 3·02 | 6·05 | 9·07 | 12·09 | 2·84 | 5·69 | 8·53 | 11·37 | 2·74 | 5·47 | 8·21 | 10·95 | 2·70 | 5·40 | 8·10 | 10·80 | 20·00 |

The slope and depth are the only data required to calculate the cubic contents of the pyramids and prisms. But with the frustrums the case is different, for the ratio of the depths is here an element and, in the tables under consideration, four different ratios of D to d are given. Intermediate ratios may be closely approximated by a proportion, but as this is troublesome and as frustrums are the solids generally met with, the writer would suggest the use of an auxiliary table, (I,) calculated in the following manner.

It is shown by Mr. S. Hughes, in the Civil Engineer and Architects Journal, 1840, p. 335, that the content calculated from the mean depth or $\frac{1}{2}(D+d)$ is less than the true quantity by $\frac{1}{12}(D-d)^2 r$, [$r$ being the ratio of base to height] and that the quantity determined by averaging the end areas exceeds the true content by $\frac{1}{6}(D-d)^2 r$, the deficiency of the former being half the excess of the latter. Now, the mean depth or $\frac{1}{2}(D+d)$ is equivalent to taking $D-d$, giving of course a triangular prism, hence, taking $D+d$ from the column of triangular prisms with the proper slope and simply adding $\frac{1}{12}(D-d)^2 r$, from a table very easily formed, we have the true content. This is almost as quickly done as to determine the ratio and take the corresponding quantity from the column of frustrums, and when the ratio is not found in the table it will save some trouble. Table I gives the correction to be added to the content due to the mean depth for different values of $D-d$ from 1 to 10 feet [for each tenth of a foot] in cubic yards per 100 feet with a slope of 1½ to 1. It may be carried as far as required by the method of second differences and the quantities vary directly as the slope or as $r$.

TABLE I.

$\frac{1}{1\cdot5}(D-d)^2\times1\cdot5\times\frac{100}{27}$.

| D—d | 0 | ·1 | ·2 | ·3 | ·4 | ·5 | ·6 | ·7 | ·8 | ·9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0·46 | ·56 | ·66 | ·78 | ·91 | 1·0 | 1·2 | 1·3 | 1·5 | 1·7 |
| 2 | 1·85 | 2·0 | 2·2 | 2·4 | 2·6 | 2·8 | 3·1 | 3·3 | 3·6 | 3·9 |
| 3 | 4·17 | 4·4 | 4·7 | 5·0 | 5·4 | 5·7 | 6·0 | 6·3 | 6·7 | 7·1 |
| 4 | 7·41 | 7·8 | 8·2 | 8·6 | 9·0 | 9·4 | 9·8 | 10·3 | 10·7 | 11·2 |
| 5 | 11·58 | 12·1 | 12·5 | 13·0 | 13·6 | 14·1 | 14·6 | 15·2 | 15·7 | 16·1 |
| 6 | 16·67 | 17·2 | 17·8 | 18·4 | 19·0 | 19·7 | 20·3 | 20·9 | 21·6 | 22·1 |
| 7 | 22·68 | 23·4 | 24·1 | 24·7 | 25·4 | 26·2 | 26·9 | 27·7 | 28·4 | 29·1 |
| 8 | 29·63 | 30·4 | 31·2 | 31·9 | 32·7 | 33·6 | 34·4 | 35·2 | 36·1 | 36·8 |
| 9 | 37·96 | 38·8 | 39·7 | 40·6 | 41·5 | 41·8 | 42·5 | 43·4 | 44·3 | 45·3 |
| 10 | 46·29 | | | | | | | | | |

Mr. Hughes' investigations led him to conclude that little aid could be derived from the use of tables, though he refers exclusively to even cutting. Take, for example, the following: width of base 20 feet, slope $1\frac{1}{2}$ to 1, heights or depths 6 and 4 feet, length 100 feet; required the cubic content. From a table of even cutting or embankment we find $\frac{1}{2}$(D+d)=5 feet = 509·2 c. yds. per ch. and adding the correction for D—d=2 feet = 1·8 per table I, we have 509·2+1·8 511·0 c. yds. the true content. Or, if we take the average of the quantities due to depths of 6 and 4 feet, we have $\frac{1}{2}$(644·4+385·1)=514·7 and deducting (twice the quantity in table I due to D—d=2=)3·7 we have, as before, 511 c. yds. per ch.

Mr. Hughes prefers calculating each area; but it is only fair to observe that he takes a quarter of a mile at a time when the ground slopes evenly, whereas the custom in this conntry is, to take a level every chain for the roughest estimates, which of course renders the correction for longitudinal slopes less important. He does not even allude to the transverse slope.

Since reading Mr. Hughes' paper, the writer has seen in manuscript these same formulæ accompanying very extensive tables for different bases, slopes and depths, taking also into account the transverse slope, which is in fact the great difficulty. These tables were made by Mr. Lewis of Philadelphia; they are preceded by a thorough investigation into and complete demonstrations of the accuracy of the principles on which they are formed and have been partially in use for many years. The corrections for the longitudinal slope in even cutting are taken from tables similar to table I in this paper, and the effects of the transverse slopes are determined in a manner entirely different from that adopted by Mr. Johnson. But, as Mr. Lewis' treatise and tables have not been published, the writer does not feel at liberty to state more, than these and those of Mr. Johnson are the only papers in which he has seen a general as well as scientific examination into the measurement of cubical quantities for canals, railways, etc., with the requisite tables for practice.

When the ground slopes transversely it becomes necessary to cut it up into the solids at the heads of the columns of Mr. Johnson's tables in the ac-

companying extract.* The central or rectangular portions may be, in all cases, taken from tables so easily formed as to require no illustration or they may be calculated with great rapidity from the column of "Rectangular Prisms." When the ratios of D to d in the side pieces are not to be found in the table then the quantity opposite D+d may be taken from the column of "Triangular Prisms," and half the correction due to D—d in table I being added, the sum will give the correct content. Half the correction only is added, because table I is calculated for both sides.

Suppose D=6 and d=4, slopes $1\frac{1}{2}$ to 1 then, the ratio being in the table we find at once the content for one side piece or frustrum=70·3 c. yds. per 100 feet. But if D=6·4 and d=3·6 then take D+d from the column of prisms=69·4 and add from table I, $\frac{1}{4}$(D—d)=1·8 c. yds. and we have 69·4+1·8=71·2 c. yds. per ch., the true content.

In this case D and d represent the *mean* depths at the ends, and another correction is required for the transverse slope, which is explained at length by Mr. Johnson, to which the writer has nothing to add, the only modification he has ventured to suggest being the additional table to give the contents of frustrums of pyramids by means of the difference in place of the ratio of their depths. In another number some views will be offered on approximate methods for preliminary surveys.

*New York, July*, 1843. W. R. C.

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The pressure of other matter compelled us to defer to the present number the conclusion of the excellent article on iron manufacture. It should have appeared in the last number, but its interest will not have suffered by the delay.

PRACTICAL REMARKS ON BLAST FURNACES.—BY GEORGE THOMPSON, ESQ., MINING ENGINEER.

[Continued from page 204.]

These general facts seem to contradict the opinion, that the whole *rationale* of the effect of the hot blast is merely a decrease in the density of the blast, because, with the inferior material, which requires with *cold* blast the *greatest* density, the *hot* blast has the greatest and *best effect*.

Those who are acquainted with cold blast working, know that most materials work best with what is technically called a "snuff" at the tweres; and to form this it is usual to blow a few inches below the surface of the scoria, which floats on the iron in the hearth. The "snuff" is a kind of arched tube formed by the cinder at the end of twere in the inside of furnace, and through which the blast passes. Now it appears to me that this natural muzzle of cinder has a great deal to do in diffusing the blast in contact with the material; and, mark that those materials which, from inferiority, required blast of the greatest density, gave the greatest trouble at the tweres, and presented practical difficulties in the "snuffing," which required a great pressure mechanically to overcome, and clear away for the passage of the blast upwards; for *such* materials, from what cause I know not, always work with great uncertainty at the tweres—sometimes having a tendency to stop up entirely, at others not snuffing at all.

If this practical difficulty could be avoided, perhaps the bad material might give a better result with a soft blast than we found it to do.

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* See page 269.

As regards the blast's density, when used hot, it must of necessity be much less than cold; for the quantity of air injected from the blowing apparatus is, generally speaking, no more with hot blast than with cold, while the area of the nose-pipes, taken together, is doubled or trebled. The diffusion of the blast by increasing the number of nose-pipes, and disposing them around the hearth, has produced great increase in make; and in some cases by this, together with increased shape, coals have been brought to work raw which with the first hot blast trials, could only be used when coked.

It seems agreed on all hands, the greater the number of the tweres around the hearth the better: and as I am aware that practical difficulties occur in doing so by the furnace "blowing forward," I will state a simple plan by which we overcame the difficulty. In building our furnace we had a round base as is now common, but instead of the usual four openings, we made five, one for the opening of the hearth, and *four for tweres.* By this method the blast from one twere does not blow against the other, and neither of them blow directly to the fore part; thus *eight tweres* may be used, two at each twere side.

More pressure is required even with hot blast to work some materials than others. For instance, we required but 2 1-2 lbs. per inch in North Staffordshire when working coke, but with coal, 3 lbs. per inch, with much greater heating surface, was required. The quantity of blast required here was very great. Blowing at four sides, we injected into a furnace fully 3000 cubic feet of air per minute, and heated to a high temperature. If this pressure happened at any time to be reduced, the effect was immediately perceptible, or if one of the tweres was taken off, a falling off in quantity and yield was the immediate consequence. The materials were, as I have before noticed, the worst I ever saw; both coals and ironstone being sulphury.

I will give only one other fact, a very extraordinary one, showing a most peculiar effect produced by a *simple increase of temperature,* at a work near Tipton, where the materials are of fair quality. The furnace upon which the experiment was made is only 11 1-2 feet at "bosh," and 45 feet high, worked with raw coal and hot blast; it produced 100 tons a week, being blown with five tweres, of 3 inches diameter each.

The cross pipes of the heating apparatus were four inches diameter, and one apparatus supplied all the tweres.

The alteration was this, the number of heating pipes was increased, the cross pipes increased in size from 4 inches diameter to 7 inches diameter, and the main pipes also enlarged; the top of the furnace widened from 4 feet diameter to 7 feet diameter; the number of tweres increased from five to six, two on each side and two at back, each of 3 1-2 inches diameter; a new steam cylinder of greater power was put to the blast engine, but the blast one was kept at the same size.

The consequence is, that more than 150 tons of iron have been produced at this furnace in one week, with an improvement of yield, and the *engine goes no more strokes,* showing that actually no more *air* is forced into the furnace than when making only 100 tons a week, two-thirds of present quantity, although with a much greater area of nozzles.

I give a short table of the pressure of blast, which shows that the quantity of blast bears no constant proportion to the capacity of furnace nor to the make. The results given from the Glasgow furnaces are taken from data by M. Dufrenoy in 1833, but since that period, the areas of nose pipes, and the number, and consequently make, have been increased as at other places.

This table shows that the quantity of blast varies with different material

to produce the same quantity of iron, especially with cold blast, with hot blast the *areas* bear little relation to the actual quantity of air injected, which cannot be arrived at without the capacity of the blowing cylinder and speed of engines.

TABLE No. II.

| COLD BLAST. | | | | |
|---|---|---|---|---|
| | Pressure in pounds. | Total area of nose pipes in circular inches. | Capacity of furnace, cubic feet. | Weekly make of iron. |
| Works near Glasgow, | 3 | 12·5 | 2500 | 45 Tons. |
| Lightmoor works with *bad* material, | 3 | 15 | 2000 | 45 " |
| Same, with *good* material, | 2½ | 12·5 | | 65 " |
| Fenton Park, with *bad* material, | 2½ | 12·5 | 1000 | 25 " |
| Corbyns Hall, Mr. Gibbons, *good* material. | 2 | 18·2 | 4000 | 115 " |

| HOT BLAST. | | | | |
|---|---|---|---|---|
| | Pressure in pounds. | Total area of nose pipes in circular inches. | Capacity of furnace, cubic feet. | Weekly make of iron. |
| Works near Glasgow, | 2¼ | 18 | 2500 | 60 Tons. |
| Fenton Park works, | 2½ | 27 | 1000 | 40 " |
| The same, with different shape of furnace, | 3 | 36 | 2500 | 70 " |
| Tipton, a work at, | 2¼ | 45 | 2200 | 100 " |
| The same, with increased heating surface, but no greater *quantity* of blast. | 2¼ | 72 | 2600 | 150 " |

The tables and statements are much more general than I could have wished; at the same time I think they sufficiently show that, 1st, there is a remarkable difference in the material of different strata in the same coal fields; 2d, that modifications of shape and alteration of capacity have a very considerable effect; and 3d, that the effect of blast is very various with different materials; that an alteration of its temperature, with certain coals, produces a saving of, in some cases one-half, in others two-thirds of the quantity, while with other coals the difference is scarcely perceptible, and the quantity of blast has little relation to the quantity or bulk of material acted upon.

The improvements in iron smelting have been effected simply by the observation and consequent successive trials of practical men; they have been the result of no principle previously established, no theory obtained from the laboratory of the chemist: and further, I think it cannot be denied that the anomalies apparent under each condition into which I have divided my results, present a problem which, as far as chemical analysis has yet gone, it is difficult to solve. And it must surely be admitted that, had these conditions been previously laid down to any one well acquainted, theoretically or practically, or both, with the manufacture of iron, together with a careful analysis of the material here referred to, he would never have predicated such results as have in reality accrued.

That the want of a guiding principle is greatly felt, and its attainment greatly to be desired, needs not to be set forth; and as there is no effect

without a cause, I do not see that the number of apparent contradictions in these ought to make us in the least despair of ultimately attaining, by the powerful aid of science, a satisfactory rationale of the whole case. This, however, will never be done by avoiding the question, by taking a partial view of facts.

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### READING RAILROAD AND THE COAL TRADE.

In our last number this road was referred to for the purpose of showing the economy which will result to the consumers of anthracite coal, from its ability to reduce the cost of transportation. More than three-fifths of the cost of our coal in New York, is paid for transportation and other expenses after it leaves the mines. Consequently, as the facilities for transportation, and handling the coal after it leaves the mines, are increased, so will the cost be reduced to the consumer.

The average cost of transportation by the Schuylkill Navigation company for the years 1835, 6, 7, and 8, was, *freight* $1 28 and *toll* 92 cents, or $2 20 per ton, exclusive we believe, of the cost of trans-shipment from *boats* to *vessels* at Philadelphia; whereas, it is now only 70 cents freight and 54 cents toll, or $1 24 per ton exclusive of cost of trans-shipment as above, thus showing conclusively what has been effected by the completion of the Reading and Pottsville railroad, and enabling us to draw tolerably correct inferences as to its future advantages to the consumers of coal, to say nothing of its utility to the travelling community and to the cultivators of the soil in the beautiful and fertile valley through which it is located.

This road may, we think, be considered a model road for a heavy business in one direction. Its grade is unequalled on a road of its length, either in this country or Europe, and its curves exceedingly favorable, for a heavy trade. There is no curve, we believe, with a radius of less than a thousand feet. The road-bed is graded the entire distance for a double track, though but a single track is laid, except at suitable places for passing the trains, and the distance of about 18 miles between Reading and Pottstown, where a second track is now nearly completed, which will greatly increase the capacity of the road for the coal business.

The superstructure is of a permanent, yet very simple character, consisting of the T rail, as it is called, of 56 lbs. to the yard, laid on cross sills of oak, 8×12 inches; resting on broken stone well rammed, in trenches.

The facilities at Mount Carbon for collecting the coal, appear well arranged; the cars of the company which are uniform in size and appearance and made to contain each 3¼ tons, are taken by the coliers to the mines, loaded and returned to the depot, where each car is weighed and then arranged in trains on the side track ready for departure. The company have now about 26 to 28 locomotives, eight being light for passengers and common freight, and the others heavy for coal; 14 passenger cars, mostly on 8 wheels; 175 freight, and 1600 coal cars, the latter are to be gradually increased to 2500, and the engines to 32 or more as may be requisite.

The arrangements for an extensive business on this road appear well

made; but with no part were we better satisfied than with the depot at its termination at Richmond, about three miles north of Market street, where the company own 45 acres of land, fronting 2200 feet on the river, a part only of which is yet improved. Here the company have seven piers, nearly completed, where 12 to 15 vessels may be loaded at the same time, and with a facility truly astonishing. These piers are built of truss work, 10 or 12 feet above high tide, with tracks laid to their extreme ends, with openings in the floor between the rails, and slides or shutes beneath, by means of which, the coal, when discharged through a trap door in the bottom of the car, is carried directly into the hold or on to the deck of the vessel along side, and so complete are the arrangements that when the car is brought to the proper place, the load can be discharged *into the vessel* in one minute, and a vessel of 200 tons loaded in a few hours, and under sail for the port of her destination the same day; and thus the coal by the *railroad* may often be unloading at the wharves in New York, while coal shipped same day by canal at Pottsville, is being trans-shipped at Philadelphia.

The freight on coal is certainly as low as it can be afforded. The fare for passengers was, we thought, too high, $3 50 for 96 miles—and we so intimated to the gentlemen in charge. We closed our article on this road, in the August number by refering to the *rates of fare*, and we promised to give them a word of advice in our next, but are happy to be able to say that the gentlemen who manage the Reading railroad have consulted better counsellors than we claim to be—their own good judgment—and their interest, and reduced their rates, as we learn from the Miners' Journal of Pottsville, for *through* passengers, from $3 50 to $2 50; and the result will, we doubt not, at least we *hope* it may be, a handsome increase of receipts for the ensuing year.

The entire amount of coal transported on the railroad last year, was 54,000 tons; this year to 25th July, 81,000 tons, and the company now run eight daily trains of 50 to 60 cars each. But they have *not yet fairly commenced* operations. It will require about three years to get thoroughly organized and in possession of the business, and then they will *average* about fifteen trains per day, of 150 tons each, for 10 months in the year.

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### GOVERNMENT AID TO RAILWAYS.

The following letter was addressed, by request, to the President of the New York and Albany railroad company, and by him transmitted to the heads of the War and Post Office departments at Washington. It was published by order of Congress. See No. 327 senate documents, 27th congress 2d session. The great importance of the subject will be deemed a sufficient excuse for its republication in the columns of the Journal.

Dear Sir: In accordance with your request, I give you my views on the subject of aid to railways by the general government. This aid, if rendered, will probably be given for the following reasons:

1. The great importance and value of railways in contributing to the defence of the country.

2. The facilities they afford for the speedy and cheap transportation of the mails.

I have long been of the opinion that the railway system, when perfected, would be found in time of war one of the most efficient means of defence.

For the rapid transportation of troops and munitions, etc., at all seasons railways are unrivalled by any other mode of communication. It is fortunate that, excelling as they do in this respect, they are, if anything, superior to other modes of artificial communication for commercial purposes. It is fortunate, also, that railways judiciously located, with a view to the latter object, connecting the larger cities by routes passing in a direction where the population is the most dense, and where, in general, the ground is the most favorable, are in the best positions for collecting the military force of the country, and concentrating it upon those points which are most important to be defended.

In all military operations celerity of movement is of the utmost importance. The history of modern warfare is indeed conclusive in this respect. With the means of quick conveyance afforded by railways, an army of a given number of men may be rendered as effective as one composed of double or treble that number deprived of those facilities, and the forces of the country may be so rapidly concentrated at any exposed point as to enable us, at short notice, to arrest the advance of an invading enemy before he shall have made a lodgment on our soil, or effected any serious injury. The citizen-soldier, who, in time of war, is to-day cultivating his fields in the interior of our own State, [New York,] may to-morrow be found battling with the enemy on the banks of the Niagara, or resisting his approach to the shores of New England.

The extent of railways already constructed and in operation in the United States amounting, in the aggregate, to upward of *three thousand* miles, together with the great extent of steam navigation on our inland lakes and rivers, places us, as it regards our ability to repel invasion, in a condition far superior to that in which we were found during the last war with Great Britain. Then there was almost a total want of all suitable means of internal communication, and, in consequence, the land operations were conducted in a comparatively feeble and inefficient manner. Now, with the means at command, and which, under suitable encouragement, will be yearly increasing, through the extension of the railway system, together with the rapid increase in the population and improvements in the arts and the defences of the country, we are, or soon will be, in a condition which will render us secure, as it regards serious injury, from the attacks of any foreign enemy.

Of the railways constructed and in operation in the United States, a very large majority have been built by private means under acts of incorporation from the several States. In some instances they have been constructed by the States; but the ill success thus far of this mode, combined with the evils of a political character inseparable from it, its expense, and the evident impropriety of making the States the common carriers of the produce of the country, renders it probable that but few railroads will hereafter be constructed as State works.

Works of this description will, it is presumed, be mostly undertaken, as heretofore, by private companies, and it is with them that arrangements must be made, if they are to be used for the purposes of the Government in the conveyance of troops and munitions of war and the transmission of the

mails. Experience has shown that the railway system, to become sufficiently general, requires the fostering aid of the government.

While the country was unusually prosperous, and confidence was firm in the success of improvements of this description, capitalists were willing to invest their funds in them. Circumstances are now different, and the aid of the government seems to be indispensable to cause the system to advance at a rate suited to the growing population and wants of the country.

The very limited aid which the general government has hitherto given to railways, by remitting the duties upon iron used in their construction, has been of great service. This aid was granted without any understanding with the companies as to the conditions on which the roads, when completed, should be placed at the service of the government. In consequence of which, the government has been, in many instances, compelled either to pay very extravagant prices, or forego the advantages which railways offer for rapid transportation in the conveyance of the mails, and for other purposes.

This should not be, and the government, in giving further aid, should secure to itself the use of the railroads upon the most equitable terms. This is the more necessary, inasmuch as it is desirable to reduce the rates of postage, particularly upon letters, which are now exorbitantly high, and, of course, to lessen as far as possible the cost of transportation of the mails.

Congress, at its last extra session, amended, or rather altered, the law relating to duties on railroad iron, so as to preclude the companies which had not then commenced the construction of their roads from benefiting by the remission of duties on that article. Should legislation stop here, great injustice will result. Of the railways in operation in the United States the majority are confined to particular States or sections of the Union. In several of the States and Territories no railroads have been constructed, and in others improvements of this description have but just been commenced. There seems, therefore, to exist a necessity founded on principles of equity that the aid of the general government should be continued to new works in the same proportion as hitherto—if not by the same mode of a release of the duties on railroad iron, by an equivalent thereto in money.

The aid thus given will fall far short of the benefits to be derived to the country from having a perfect system of railway communication constructed and ready for use on reasonable terms. I would therefore propose, with a view of giving the requisite encouragement to the prosecution of new works, and of securing for the use of the government, on reasonable terms, those already in operation, that *further* aid be rendered as follows, viz:

All lines of railway completed and ready for use of not less than fifteen miles in extent to be entitled to a fixed sum per mile, say *twenty-five hundred dollars.*

In consideration of the aid thus given, the several companies to bind themselves—

1. To convey the government mails as often as twice each day in opposite directions over the whole extent, or any portion of their respective roads, at a speed of not less than seventeen miles per hour, at the following rates of compensation:

For every mail weighing two hundred pounds or less, ten cents per mile.

For each one hundred pounds additional one cent per mile.

2. Each mail to be accompanied, if required, with a deputy postmaster or attendant, for whose conveyance no charge is to be made; and at all points on the line where mails are to be exchanged sufficient time to be allowed for the purpose.

3. If the mail is required to pass four times daily over any road, twice in

the same direction, then, for this additional service, the rates to be the same as above, unless a locomotive is run especially for the purpose, in which case the compensation to be fixed by three disinterested persons, which compensation shall not exceed treble the rates above stated.

4. For the conveyance of ordnance and military and naval stores of every description for the general and state governments, per ton per mile, two cents.

5. If the amount of ordnance and military or naval stores conveyed as above at any one time by a locomotive expressly detached for the purpose is less than fifty tons, the rate to be one dollar per mile for the whole load. If over fifty tons, the rate not to exceed two cents per ton per mile.

6. For conveying each person attached either to the regular army, the militia, or the navy, below the grade of commissioned officers, when in service, either in peace or war, one cent per mile.

These conditions should be binding, not only upon the railway companies, but upon their successors owning the roads.

The several prices or amounts stated may not be the best or most judicious in each case, but it is believed that the outlines of the plan are such as will prove most equitable to the companies, and economical and effective to the government.

The plan which has been suggested of paying to each railway company a gross sum in advance for the transportation of the mails during the existence of their respective charters, is objectionable, as it tends to inequality and injustice in the compensation to different companies, and will require to effect it a greater present outlay of funds than it may be convenient for the government to furnish. It is objectionable, also, in consequence of the difficulty of anticipating the future wants of the government, and ability of the companies to fulfil their engagements.

The causes which have hitherto produced a rapid improvement of the country, are still in existence, and will under a restoration of confidence, which is sure to take place, continue to produce its legitimate effects, rendering it impossible to predict the changes which even a few years may produce.

New and more direct thoroughfares may be opened, causing an entire change both in the weight and periods of transmission of the mails. Where now the mails are lightly burdened, the weight may be found greatly to increase, and the intervals of their transmission lessened, and the reverse.

The companies having received compensation in full in advance will have no sufficient inducement to fulfil faithfully and promptly in all cases their agreements, even if they have the ability to do so, and may be disposed to embarrass as much as possible, without violating the strict letter of their contracts, the operations of the post office department for the purpose of securing additional and exorbitant compensation.

By this plan also, the government is placed at the mercy of the railway companies, as it regards the use of their roads for military purposes, thus depriving itself of one of the greatest advantages to be derived from contributing its aid to the construction of railways.

The two objects of military defence and the conveyance of the mails should not, I think, be separated in legislating upon this subject.

The public welfare is intimately connected with both, and they are both, it is believed, clearly within the constitutional powers of congress to foster and promote in the manner above described. Railways at the present day are indeed *indispensable* for both purposes.

The amount of two thousand five hundred dollars per mile may be great-

er than is necessary to place these works at the service of the government, but even that will not amount to a large sum in the aggregate.

The total extent of railway now in operation in the United States is about *three thousand* miles, which, at two thousand five hundred dollars per mile, is *seven and a half millions* of dollars, a sum small in comparison with the advantages the country will derive from being able to avail itself in case of war, and for the other purposes mentioned, of the roads now in use, even if there should no stipulations be entered into, as to the terms on which transportation for the government is to be conducted.

The very great utility and importance of railways in a military view, do not seem to have been, as yet, fully appreciated.

All those sea ports which have these communications with the interior, possess resources and means of defence of almost incalculable value.

Among the most favored of their number is the city of Boston. From that city five lines of railway radiate in as many different directions into New England, and one of them after traversing the length of Massachusetts, enters the State of New York, and connects at Albany with the lines of railway extending west and north of that city.

By means of these railways the city of Boston is enabled to command within two to four days' notice, at all seasons of the year, the whole disposable force spread over New England, and northern and western New York. The grand depot of the government arms and munitions for the northern section of the Union at Watervliet on the Hudson river, is now brought within twelve hours of Boston. Thus situated, the city of Boston possesses resources and a degree strength to resist invasion which is not possessed by New York. The latter city, unlike every other leading city on the Atlantic seaboard, has no direct railway communication with the interior of the country. In winter she is cut off except by a circuitous route through other States, and the exposed navigation of Long Island sound, from all access to the great military depot, at Watervliet, above mentioned, and from the aid which, in case of an attack, would instantly rally to her defence, from the west, the north, and the east.

The construction of the New York and Albany railroad will supply to New York city, more than any other work of internal improvement, the means of defence, giving her all the advantages in this respect possessed by Boston.

The proportion of government aid which would fall to this work, at the rate above proposed of two thousand five hundred per mile, will be three hundred and seventy-five thousand dollars, a sum not greater than the cost of one of the steam frigates recently constructed,* and not requiring like them, the *additional expenditure of large sums annually*, to maintain and preserve in a condition for use.

Of the great value of the railway in its ability to contribute to the defence of the city, there can be no doubt. If constructed and operated in the best manner, with a branch connecting with the eastern roads, the force of men and ordnance which might be brought to New York, at short notice, could not, from its magnitude, be easily computed.

By an attentive consideration of the subject, we shall not fail to discover in the railway system, the elements of great strength in a military view, so essential to our independence and safety, the importance of which is so often

* The steam frigates referred to are the Missouri and Mississippi. The cost of the former, as since ascertained is $566,458·28, and of the latter, is $553,759·931. This is exclusive of the large amount recently expended in abortive attempts to dispense with the chimney or smoke pipe in the former vessel.

lost sight of, so easy is it in times of peace to forget that wars have been, and that the feelings and passions of mankind have in no wise materially changed.

To those who view with regret the necessity which exists of expending large sums in the erection and maintenance of the defences of the country, to enable us to resist encroachments upon our rights from abroad, it will be gratifying to know, that the government in giving its aid to railways for the purposes mentioned, is at the same time promoting in the most effectual manner a system of improvements, which, more than any other, is calculated to contribute to the prosperity of the country in a commercial view, developing more completely its resources, facilitating the early transmission and diffusion of intelligence, and uniting with stronger bonds the different sections of the Union.

EDWIN F. JOHNSON,
*Chief Engineer New York and Albany Railroad.*

*New York, April* 9, 1842.

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GREAT PERFORMANCE OF A LOCOMOTIVE STEAM ENGINE.

The following statement appeared in the United States (Philadelphia) Gazette, sometime since, but its re-publication in the Journal has been delayed in the expectation of receiving further particulars, in relation to the engine from the manufacturers. They have, however, been so occupied that they have not been able to furnish the desired description; we therefore now give Mr. Campbell's account of the performance on the Columbia road, and think we may promise our readers something further of interest from the same manufactory at an early day, as Messrs. Baldwin and Whitney have made an engine for the Western railroad, which is soon to be tested on its heavy grades, and, from what we learned on a recent visit to their manufactory, we anticipate very favorable results.

We would say, in addition to Mr. Campbell's report that the engine referred to by him, as we are assured by an intelligent friend who witnessed its performance, turned a curve of 90 feet radius repeatedly without any difficulty.

*Mr. Editor*—Messrs. Baldwin and Whitney, engineers of this city, have recently made and patented valuable improvements in their locomotive steam engines, by which the weight upon each pair of wheels is equalized, the facilities for turning curves and conforming to the undulations of the rails increased, and the efficiency for carrying freight, in proportion to the aggregate weight and cost of the engine, nearly doubled as compared with engines of ordinary construction. One of these engines, on six wheels, all of which are connected, was recently finished and placed on the "Philadelphia and Columbia railroad" for trial, where its performance fully realized the expectations of the makers.

The weight of this engine, in running order, including two men, water, and fuel, is 28,500 lbs. or $12\frac{72}{100}$ gross tons. The weight of the tender with a full supply of fuel and water, is 25,275 lbs. or $11\frac{28}{100}$ gross tons.

The undersigned feeling an interest in all improvements of so much importance to the public, and in the success and economy of railroad transportation, made several trips upon this engine, across the Columbia railroad, in company with Mr. Whitney, one of the builders, with a view of testing its merits. Upon these several occasions, its performance was as follows:

On the 17th of the present month, it drew from the station at the head of the Schuylkill plane, to Columbia, 32 loaded cars, including a three section portable boat, weighing altogether 165 tons 5 cwt., 2 qrs. 13 lbs. exclusive of engine and tender, in 8 hours 30 minutes, running time, distance 78 miles.

On the 18th it returned from Columbia, drawing 40 loaded cars, weighing exclusive of engine and tender, 204 tons, 13 cwt. 2 qrs. 14 lbs. in 8 hours 45 minutes, distance same as before, 78 miles.

On the 22d a full train westward, could not be obtained: The engine started from the Schuylkill station with 20 loaded cars, which were increased at the stations along the line, to 40 cars, generally without cargoes, the engine at no time drawing over 110 tons, exclusive of its own weight and tender.

On the 23d it left Columbia with 47 loaded cars weighing 249 tons, 19 cwt. 3 qrs. 13 lbs., which it drew up all the grades upon the road, to 39 feet rise per mile. It drew 39 of these cars, (including a three section portable boat) weighing 233 tons, up grades 45 feet per mile, time of running 78 miles, 9 hours 18 minutes.

On the 18th the engine evaporated 499½ cubic feet of water, accurately measured, and consumed 2 $\frac{25}{100}$ cords of dry oak wood, and 40 bushels of bituminous coal. On the 23d it evaporated 519 cubic feet of water, and consumed 2 $\frac{34}{100}$ cords of dry oak wood, and 40 bushels bituminous coal. The wood was of good quality, but the coal was unsuitable. It was very fine, and large quantities of it was carried out with the blast from the exhaust steam pipes unconsumed.

Besides the resistance resulting with the *friction* of cars or wagons of a train, an additional resistance occurs from the *gravity* of the whole mass upon the plane. That gravity is the force by virtue of which the train would descend the plane if not resisted, and is equal to the weight of the mass divided by the number that indicates the inclination of the plane.

If therefore, in the case of the ascent of a grade of 45 feet per mile which is one foot in 117½ on the 17th with a train of 165 tons, 5 cwt. 2 qrs. 13 lbs. and the engine and tender weighing 24 tons, the total weight of the mass would be, 189 tons, 5 cwt. 2 qrs. 13 lbs., which divided by 117½ gives the gravity 3613 lbs., which added to the resistance from friction of the cars at 8 lbs. per ton or 1320 lbs. gives a total resistance of 4933 lbs. overcome by the engine, (exclusive of the friction of the engine itself) which on a level railroad, is equal to a train of 616 tons.

On the 18th the resistance overcome by the engine on 45 feet grades was 5997 lbs. which was equal to 749 tons on a level railroad.

On the 23d the resistance from gravity and friction, on 39 feet grades, was 6532 lbs., which was equal to 816 tons on a level railroad. Or in other words the power of the engine exerted horizontally on the rails, would have lifted a weight perpendicularly, if attached to a rope working over a pulley, of 6532 pounds.

The above performances are greater by far, than those of any other engine of the same aggregate weight, known to the undersigned. The improvement is of great value, and really enhances the value of every railroad in the Union, having extensive sources of trade.

H. R. Campbell, C. E.

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PROGRESS OF THE DOCTRINE OF LOW FARES.

It was not without quite an effort that this doctrine was adopted this season, on the Western railroad, from Worcester to Albany, but its friends finally prevailed, and the result is as we anticipated, a large increase of pas-

sengers, equal during the month of May to 79½ per cent. and during the month of June, to 105 over the corresponding months of 1842.

The Boston and Providence road also adopted the doctrine; the Paterson road followed, and now several of the southern roads *south* of Washington city, as we learn from a gentleman in Richmond Va., have adopted lower rates. He says that the fare is now only $20 from Washington to Charleston, S. C., while it is an *eighth* of that amount, or $2 50 from Baltimore to Washington—40 miles, or over six cents a mile on one of the greatest thoroughfares in the United States. This is a sad mistake as we understand the laws of trade, and will inevitably lead to an opposition line of stages which, though it may not be successful, will injure the railroad by exciting a spirit of hostility not only to that road, but also to the whole system for a time.

We would not have a company reduce their rates so as to injure the stockholders, or to prevent their receiving a fair income upon their investment; we know of no capitalists who are better entitled to liberal dividends than those who invest in works designed to facilitate communication between distant points, as they make neighbors and friends of strangers; and it is precisely on this account that we advocate a system which we believe has in nine cases out of ten, where adopted, tended directly to increase the receipts and dividends; and hence it is we desire to see the fare reduced between New York, Philadelphia, Baltimore and Washington city, on all of which roads the charges are exorbitantly high when compared with other railroads, and the travel over them.

The charge from New York to Philadelphia $4, Philadelphia to Baltimore $4, and from Baltimore to Washington $2 50, or $10 50 for 234 miles is, in *these* days, on *such* a route, entirely too high, and *must* come down.

It will be said perhaps, that the Camden and Amboy charge only $3 in the morning, to and from Philadelphia, and that by the way of Newcastle and Frenchtown only $2 is charged between Philadelphia and Baltimore; true, and it is because they can *afford* to carry passengers between New York and Philadelphia, and Philadelphia and Baltimore at lower rates and *do not*, only when *obliged* to, that we complain. Their own interest would, as we contend, be ultimately, if not immediately, promoted by adopting lower rates. Of this we have not a shadow of doubt, though we may be in error. We give the annexed, from the Boston Traveller, of 29th July, in support of our position, and shall look with much interest for the regular monthly reports from those roads which have adopted low fares.

*Western Railroad.*—A correspondent furnishes the following statement in relation to the low fare policy and its effects upon this road.

In March and April last, the expediency of reducing the rate of fare on this great line of communication was elaborately discussed in the public prints, and two tickets were run for directors, one of which was styled the low fare ticket. The election having resulted in the choice of a majority of the low fare party, the first and second class rates for through travellers

were reduced in April last from $5 and $3½, to $4 and $2 7/10. The measure has been silently in progress for the last sixty days, and while little gain appears in the way travel as compared with the the corresponding months of last year, an increase of nearly *one hundred per cent.* occured in the number of through travellers, materially augmenting the revenue of the road, although a disproportionate share is paid to the Boston and Worcester railroad company who would not concur in the reduction.

| | |
|---|---|
| Number of through passengers for May, 1843, | 2659½ |
| Number of through passengers for May, 1842, | 1482½ |
| Gain 79½ per cent., | 1177 |
| Number of through passengers for June, 1843, | 3813½ |
| Number of through passengers for June, 1842, | 1866 |
| Gain 105 per cent., | 1947½ |
| Aggregate for May and June, 1843, | 6473 |
| Aggregate for May and June, 1842, | 3348½ |
| Gain 90½ per cent., | 3125½ |

These passengers being way-billed, having no tickets, except for the first stage, and no privilege to stop on the line, except while the train stops, cannot convert their tickets into way tickets.

In addition to the great increase of numbers this measure has given (as predicted) an impulse to the freight, the through freight from Boston to Albany having been trebled in May and June last, as compared with the same months of the preceding year.

We are happy to learn the low fare is succeeding equally well with the way travel on the Worcester railroad, as evinced by the remarkable success of the special train at 2 cents and 1½ cents per mile, between Boston and Newton.

Since the above was written, we learn from the Miners' Journal, of 29th July, that the managers of the Philadelphia and Reading railroad have reduced the fare for through passengers from $3 50 to $2 50.

## RAILROAD ACCIDENTS.

It is much easier to complain of accidents on railroads than to point out the means by which they may *always* be avoided, yet so frequent have they become of late, that it is well worth while to inquire whether some of them at least, are not the result of carelessness, or something less excusable.

But a short time since we cut the following from the Hartford Courant.

"The railroad cars, on Saturday afternoon, were an hour or two behind their usual time. The detention, we understand, was occasioned by a horse which ran along the track, in front of the engine, for several miles, and finally stumbled. The cars passed over him, crushing him of course. The baggage car was thrown from the track, and one of the other cars was somewhat injured. No other injury or loss was occasioned."

An engine-driver who would be guilty of thus jeoparding the lives of his passengers and at the same time of torturing so noble an animal as the horse, deserves instant dismission from employment in a position where he can gratify his mischievous propensities at so great a hazzard to others.

The ink was scarcely dry which recorded the above, when we read of an accident on the Baltimore and Ohio road, from a cow on the track. Fortunately, very little damage was done in this case; it will, however, be exceed-

ingly difficult to avoid a repetition of similar and perhaps fatal accidents on this road, with its numerous short curves, unless measures are adopted to keep cattle off from the track, which *must* be done.

The next on the list of railroad accidents was on the Utica and Schenectady road, which fortunately, was more disastrous to the company in the destruction of engines and cars than to the passengers, who, providentially, escaped without injury. There was not, it appears to us, in this case, due precaution used by the superintendant, in allowing the up train to start until the other train arrived. There should be a rule, invariable, never to send out one train, on a single track, when another is due. Such a rule if never deviated from would insure greater punctuality in starting, which is also important, and should be insisted on by travellers, or rather by the *directors* of the companies.

It was stated in some of the papers that the up passengers were not along —only a few empty cars—when the collision took place, but we have been informed by a gentleman who ought to know, as his wife was in one of the cars, that the passengers were along. The censure in this case should not fall wholly on the managers at Shenectady, but mainly on those at the western termination who disregarded their pledge to start at a given hour, to increase thier passengers, should be held responsible, and made to feel the full force of the public indignation. It is inexcusable thus to trifle with those who travel, and keep hundreds waiting for hours and then risk their lives, that a few more passengers may be taken to-day instead of to-morrow, or perhaps it would be as near the truth to say, be *kept from the packets.*

Another accident occurred on the Philadelphia and Wilmington railroad on Sunday night, 30th July, as it appears from a Baltimore paper, from sheer carelessness, that is, from sending out an extra train upon a single track road, before the other train had arrived. Fortunately, no passengers were injured, yet the engines were destroyed.

The last and sadest recent accident, of which we have now, Aug. 4th, any account, took place on the Reading railroad, and from the information before us, it appears to us, as the Philadelphia Forum says, is wholly attributed to "the carelessness of the agent," who should have detained the up train until the other train arrived.

There must be *system* and *order* and *punctuality* on a railroad with only a *single* track, to avoid accidents, and there should be a more thorough police, until a system of telegraphic signals shall be established, as we hope may soon be the case, on our main lines of railway.

RATES OF FREIGHT FROM ALBANY TO BOSTON, 200 MILES.

In *first* class cars, through, $7 per ton, or 3½ cents per ton per mile, for enumerated articles, and $4 per ton, or 2 cents per ton per mile, for other articles in *second* class cars. When in quantities of 6000 lbs. or over, and notice is given before hand that there will be as much as 6000 lbs, a deduction of 20 per cent. is made from the above rates, on certain specified articles.

Flour to Pittsfield, 27 cents; to Springfield, 33 cents; to Worcester, 34

cents, and to Boston 30 cents, it being less trouble to take it through than to leave it on the way.

Live stock, horses and horned cattle, not over four, by special contract. The same, over four, at first class rates. All other live stock will be charged, between

| | | | |
|---|---|---|---|
| Greenbush and Brighton | $8 | per 2000 | lbs. |
| Pittsfield | " 7 | " | " |
| Springfield | " 5 | " | " |

and in proportion from intermediate places.

Sheep and lambs are estimated at 100 and calves at 125 lbs.

Swine in quantities less than 3½ tons, in one consignment, to be charged at 3½ tons; live stock to be fed at the owners cost.

The above abstract, is from the rates established 10th April 1843, a copy of which, together with a copy of the rates for 1842 we request the gentlemen managing the road to forward us; and the managers of each road in the United States are requested to do likewise, that we may show a comparative statement.

## GOVERNMENT AID TO RAILROADS.

An important document will be found in this number of the Journal in relation to national aid to railroads, with the view of securing to the government all the advantages of railroads for the transportation of the mails, troops and munitions of war, at low rates and stipulated uniform prices. The subject is one of vast and growing importance, and we consider the present period peculiarly appropriate for the United States government to consummate an arrangement with the numerous railroad companies now in successful operation, which shall be mutually advantageous to both parties and highly important to the government in time of war, for the transportation of men and munitions, and to the *people* at *all* times for the transportation of the mails.

Many companies would be more benefited by receiving a small bonus, which might enable them to liquidate present liabilities and put their road in more complete and efficient order, than by double the amount at a future period; and the government can with great ease accomplish the desired object by the issue of a five per cent. stock, redeemable 30 years hence, during which period the entire amount of the stock would be saved to the government in the reduced cost of transportation; and it would be no compliment to the sagacity of the gentlemen at the head of the different departments, requiring the use of railroads, to suppose they do not perceive that a much more favorable arrangement can now be made than at a later period, when the different companies shall have surmounted their difficulties and completed their roads.

## WOODEN COUPLING BARS.

The advantages of this mode of connecting cars have long been known, and yet its use is, as far as we are aware, quite limited, as we have seen

wooden connections used on but few roads. The following is one of many instances that might easily be brought forward in favor of this simple and yet highly useful invention.

"We learn that the passenger cars in the Cumberland train which ran over a cow, on Wednesday night last, were connected to the wood car by *wooden coupling bars*, which broke when the engine went off the track, and the cars were thereby uninjured. This mode of connecting the passenger cars upon the Baltimore and Washington railroads has been in use for some years, and the superiority of the plan is made manifest whenever an accident similar to the above has occurred."—*Balt. Pat.*

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CANAL TOLLS.

The following statement in relation to the canal tolls, is from the Albany Argus:

"Account of tolls received on all the canals of the State, during

| | 2d week in July. | Total to 14th July. |
|---|---|---|
| 1839, | $32,784 | $681,179 |
| 1840, | 39,512 | 627,807 |
| 1841, | 45,813 | 793,629 |
| 1842, | 35,789 | 666,246 |
| 1843, | 51,038 | 719,570 |

Account of flour and wheat arrived at tide water during

| | 2d week in July. | | Total to 14th July. | |
|---|---|---|---|---|
| | Flour, barrels. | Wheat, bushels. | Flour, barrels. | Wheat, bushels. |
| 1842, | 30,154 | 7,059 | 481,865 | 176,757 |
| 1843, | 72,344 | 15,242 | 558,931 | 147,421 |

Amount of tolls received at Albany on the Erie and Champlain canals:

| | 1842. | | 1843. | | |
|---|---|---|---|---|---|
| April, | $14,326 07 | | | | |
| May, | 46,766 43 | | 60,646 27 | | |
| June, | 23,688 27 | | 26,311 47 | | |
| July, | 23,292 13 | 98,072 90 | 25,249 47 | 112,207 21 | |
| | | | | 98,072 90 | |
| Increase to 31st July, | | | | $14,124 31 | |

Account of tolls received on all the canals of this State, and of the locks ages at Alexander's lock, three miles west of Schenectady, to the 1st Aug.:

| | Tolls. | Passages at Alexander's lock. | |
|---|---|---|---|
| 1839, | $761,423 | 10,646 | |
| 1840, | 716,526 | 11,555 | |
| 1841, | 912,224 | 13,486 | |
| 1842, | 750,951 | 10,090 | |
| 1843, | 858,485 | 9,668 | |
| The increase over last year is | | | $109,534 |
| Of this increase there is at Buffalo | | 68,459 | |
| " " West Troy | | 28,424 | |
| " " Albany | | 6,368 | 103,251 |
| Leaving for increase at all other offices, | | | $4,283 |

The $103,251 represents the increase of produce from, and merchandize to, western States, by the way of Buffalo. The $4,283 represents the increase over last year in the *home business*, or business of this State."

RAILROADS IN MICHIGAN.

We learn from the Detroit Free Press, though *we do not receive it*, but should like to, that there is now in successful operation in Michigan, 147 miles of railroad, as follows:

| | | |
|---|---|---|
| "From Detroit to Jackson, - - - | 80 | miles, |
| " Monroe to Hudson, - - - | 42 | " |
| " Detroit to Pontiac, - - - | 25—147 | " |

The cars will soon run 40 miles further on the Central road—from Jackson to Marshall, and 16 miles further on the southern road, from Hudson to Hillsdale, which will then give us 203 miles of railroad. We think this pretty fair for the youngest State in the Union."

So do we, and give the young State of Michigan full credit for her enterprize, and hope to see her persevere in her onward course which will certainly place her in an enviable position in a few years—especially if she *repudiates* that infamous doctrine of "repudiation."

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*Boston and Worcester Railroad.*—We learn from the Boston Mercantile Journal that the second track upon this railroad is completed through its entire length from Boston to Worcester, and is now opened for use. We hope now to hear soon that the directors have also adopted lower rates of fare, so as not to throw the entire reduction made between Albany and Boston upon a part of the route.

We learn that the Mohawk and Hudson railroad company have effected a loan from the city of Albany of $150,000 at 5 per cent. With this money the company are to construct a new route of their road, which will terminate within the city limits, and will dispense with the inclined plane, now in use at the eastern termination. This change of route on the Mohawk road will be a great convenience to travellers. The inclined plane at Schenectady has been, or is about to be, dispensed with by adopting a new route. We should like to see a full statement of the actual cost of this road, from its commencement. It would show what experience sometimes costs. It should, however, be borne in mind that this road was commenced when inclined planes and locomotives to run on 33 freet grades, and haul 20 tons on a *level* road at the rate of 10 miles an hour were the order of the day, and considered great performances.

The Brownsville (Penn.) News, says that out of a drove of 700 sheep which stopped at Beallsville, Washington Co., Pa., after one days drive 405 were found dead next morning, from having been over driven. This would not have occurred on a railroad.

Paterson railroad fare reduced from 37½ to 25 cents. Good.

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*Railroad Reports* received since our last and will be noticed in our next number. South Carolina Canal and Railroad company, July, 1843. Georgia Railroad and Banking company, May, 1842 and 1843.

*Rates of Fare and Freight* received since our last and will be noticed

in the next number. A tariff of Freights and Passage on the South Carolina Hamburg and Columbia railroads; and on the Georgia railroad between Augusta and Madison; an abstract of which, we shall give in the October number. Will the managers of *other* roads please furnish us with a copy of their established rates? We design to make a table showing the rates comparatively, on all the railroads in the United States, if we can obtain them.

*Otis' Excavator*, of which an interesting description is given in this number, are to be used extensively on the St. Petersburg and Moscow railroad, in Russia. One machine was sent out last year, and three more, just completed by Eastwick and Harrison, Philadelphia, are now ready for shipment; and we understand that the owners of the patent, Messrs. Fairbanks and Carmichael, have taken a contract for the excavation of 25,000,000 cubic yards on this road.

*Spring Steel for Locomotives, Tenders and Cars.*—We desire to call the attention of manufacturers and others interested, to the following advertisement of J. F. Winslow, Esq., of the *Albany Iron and Nail Works*, at Troy, of *Spring Steel.* Mr. Winslow is, we believe, quite extensively engaged in the manufacture of steel, and from what we have seen and heard we believe he furnishes an excellent article.



☞ Thanks to those subscribers who have so promptly responded to our call upon them. If each present subscriber will do as some have already done—send two new names and cash with their own payment, in advance—the Journal will not be likely to lose time again soon.

☞ Thanks also to those Editors who have, in so kind a manner, noticed the Journal, and offered to receive subscriptions to it. As it is the only work of the kind published in this country, devoted mainly to Internal Improvements, in which all classes of people, and all parts of the country, have a deep interest, we shall be greatly indebted to all who will call attention to it as it appears, monthly, and send us, those who do not now, theirs in exchange. The Journal has been sent to Editors without the cover, in order to save them postage, and thus the whereabouts of its publication was omitted. It was presumed, however, that every Editor in the country, who had been long in the chair, knew where the Railroad Journal was, or had been published.

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AMERICAN

# RAILROAD JOURNAL,

AND

# MECHANICS' MAGAZINE.

Published Monthly at 23 Chambers-st. New York, at $2 a-year, in advance, or 3 copies for $5.

By GEO. C. SCHAEFFER, and D. K. MINOR, Editors.

No. 10, Vol. 1. Third Series.

OCTOBER, 1843.

Whole No. 429. Vol. XVI.

## RAILROAD POLICE.

Although we have often referred to this subject, we are convinced that much more may be said, and in fact must be said, in order to excite the proper feeling in regard to the most important branch of railroad economy.

The organization of a complete system of railway police is no slight task, and the difficulties are much increased by the essential differences which must prevail in all the minute details upon each line of road. Nevertheless, there are certain general principles which must in all cases be carried out, and the differences caused by local and peculiar circumstances are in all cases to be considered as the results of these principles.

The frequent occurrence of accidents of even trifling character, is most zealously to be avoided—as the confidence of the public becomes impaired and the character of railroads generally, is injured. Certain accidents may be considered as unavoidable, but none should be unforseen and unprovided for, and the strict adherence to this view will of itself be the means of preventing many mischances. For example, any malicious obstruction sufficient to throw the engine or cars from the rails may be, as far as the company is concerned, strictly speaking unavoidable, yet the proper provision for this or similar occurrences will prevent unnecessary delay, which would produce an entire derangement along the whole road, and almost as a matter of course entail further accident.

As a general rule the greater the power and extent of any machinery the greater is the mischief resulting from any derangement of its operations, and this certainly holds good for railroads, as experience has fully proved.

The first grand principle is the preservation of life and property, and here the interests of the public and the company are concomitant, whether we regard the property of the company or that of the public or the lives of travellers or of the company's agents, the loss of one is sure to bring about the loss of one or more of the others, and injury to either is detrimental to the interests of all parties. No one doubts that wanton carelessness, resulting in loss of life is to be blamed and punished as the highest degree of man-

slaughter, and yet how very frequently can this wanton carelessness be detected, even though it may consist in the omission of a screw or a bolt in the machinery or of a single word in an order.

Next to the safety of person and property, *despatch* is the most important principle in railroad management, and without it the advantages over other modes of conveyance are wholly lost. It is not enough that an extraordinary trip has been or can be made, but swift passages should always be insisted upon, and regularity in this respect is more productive of traffic than any other cause.

Thirdly, the personal comfort and convenience of travellers should be carefully studied, and attention to this principle involves very many particulars. Cars should be comfortable and *clean*—the depots protected from the weather—the arrangements for the reception and distribution of baggage should ensure safety and despatch, the times of starting should be convenient and when determined upon, conspicuously published by advertisements and by notices at the depots—all changes should be made known a suitable time previous to going into operation and the time advertised should be punctually adhered to—civility and politeness on the part of all the agents of the company should be most strictly required. These are a few of the many items falling under this head, and of their importance there can be no doubt. It must be remembered that among travellers there will always be found a portion of invalids, females, children and of those who are not so wide awake as to know where to go and how to avoid danger without the plainest directions and the absence of all possibility of getting into mischief. Such is the travelling public as it is found and for such provision must be made.

The chief means of carrying out these principles is the promulgation of simple and comprehensive yet definite rules, and although these rules may be frequently broken without any serious result, yet to permit habits of inattention, fines should be exacted for every violation of orders—a method of securing attention and obedience which is calculated to succeed admirably if we are permitted to judge from the experience of those who have adopted it.

These rules should not only contemplate certainties, but provide for contingencies—"*if* such and such a delay takes place you are to do so and so," —and it is in this very point that the excellencies of a system of police are shown. If any accident happens, every thing still goes on with regularity and decision and the passengers are at once reassured by the absence of either stupid indifference, or visible trepidation and indecision in all the agents of the company. At the same time no solicitations or entreaties should be allowed to induce any one to depart from the rules laid down, and one good effect of such rules would be to prevent any such interference, simply by doing away with the necessity for it—but when passengers find there is no law and no order and that no means have been taken to ensure their comfort or to preserve their lives and property—they have a sort of right to in-

terfere, for self preservation, although, unfortunately in such cases they know as little what to do or how to do it as those who have got them into trouble.

A very good because very simple method of saving time and trouble, is the adoption of a badge or uniform by which all the persons connected with the railroad may be at once detected, and the addition of a label designating each man's office. This latter also incidentally insures another advantage —it prevents the making of "men of all work" doing everything, and nothing properly.

Such, in fine, are a few of the means of forming a correct system of police, but the best way of arriving at the details will be the publication of the rules adopted by each company, together with the local or other reasons for any peculiarities which may exist. With this view we would solicit from railroad companies and engineers, a copy of such rules as they may have adopted, for publication in this Journal—the result of comparison of information thus obtained will lead to a mutual improvement, give confidence to the public and insure profit to the railroads.

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CHESAPEAKE AND OHIO CANAL.

The Baltimore Clipper of August 19th, says:—"The American of yesterday announces the election of Col. *James M. Coale*, of Frederick, as president of this company, in the place of Gen. McNeil. This change was made by the meeting of stockholders held in Frederick on Thursday last. This act we presume, is to be understood as intending to exhibit the disapprobation of the stockholders, of the contract lately made between General McNeil and Messrs. Leston & Co.; and leaves no room to doubt that the work which had been commenced under the contract will be discontinued. Notwithstanding this decisive disapproval of the course pursued by General McNeil, we doubt whether it would not have been more politic to have permitted the contractors to expend the $100,000 as contemplated—for, as we understand the contract, they could not have proceeded further without special legislation; and of course their claims would have been limited to the tolls on the portion of the work constructed by them, for interest on their outlay, while the principal was not to be redeemed in less than twenty years.

We regret the misunderstanding between General McNeil and the company, because we consider him an efficient and experienced officer. Heretofore he has always, we understand, given entire satisfaction to the companies by whom he has been employed—and in regard to this company, we cannot believe otherwise than that he has acted with a conscientious conviction that he was doing what was just and right, and most conducive to the company. The contract he entered into being now annulled, what is to be done? The work yields nothing, and interest is accumulating. In this condition it is out of the question for things to remain long. The canal must be pushed ahead, or the State's interest in it be sold, even at a sacrifice —for it would be the grossest folly to continue a tax of more than $400,000 a year for a work which is not even progressing to completion, and which of course holds out no hope of reimbursement."

It is much to be regreted that this great work is to be still longer delayed. We do not pretend to understand the merits of the controversy between the president and the company, but on a recent visit to Cumberland we came to

the conclusion that the completion of the canal to that place is of the first importance to the stockholders as well as to the owners of the coal and iron region about Cumberland; and it is singular indeed, that when so much has been done, and so little, comparatively, remains to be done, *Maryland and Virginia* and the *District of Columbia* should allow it to remain unfinished. Perhaps this controversy may effect, by arousing the people to investigate the matter, what the president is not allowed to do under his late contract. The town of Cumberland and its vicinity as well as the District of Columbia, have a deep interest in the completion of this work; and it appears to us that the *whole* income of the canal for a period, had better be given to those who will loan the company the means of completing it to the coal region, for it is in fact a loan by the contractors to the company for twenty years, thus to receive the tolls on that part of the canal between dam No. 6 and Cumberland, opened by the expenditure of $100,000 by the contractors.

Since the foregoing was written, we find the following remarks and protest in the Baltimore Clipper, which shows conclusively, as it appears to us, that the gentlemen representing, or rather *mis*representing the interests of Maryland, have done their late president very great injustice; and they must make out a very strong case of transcending his authority and instructions, or they will find him riding them rough-shod before they are aware of it. As the General says, "we shall see."

"*Chesapeake and Ohio Canal.*—The summary dismissal of General Mc Neil from the presidency of this company, by the agents of the State of Maryland, without the formality of referring the subject to the consideration of a committee, or affording him the opportunity for explanation and defence, is considered harsh and unjust, and will become a matter for the investigation of the legislature. It seems, from the following protests, that the measure was in opposition to the wishes of the representatives of the large stockholders, with the exception of Maryland; and courtesy towards those representatives should have induced less precipitancy on the part of the agents of Maryland.

"General McNeil was invited to the station he lately occupied; and, we understand, left a more lucrative situation to accept the presidency of the company. He felt desirous to push the work on to completion with the least possible delay, and he had every reason to presume that the board felt like anxiety, as a resolution was passed, expressing a willingness to contract for finishing the work to Cumberland on the precise conditions, we believe, of the contract which has given so much offence. But if the president were even in error in making the contract in question, it did not afford a justification for his *sans ceremonie* dismissal from office, as there cannot be a doubt that in what he did he had in view the interests of the company. Having been denied the privilege of making his defence before those who discharged him, he will, we are informed, give an exposition to the public; when, we shall be much mistaken, if he do not show that he has been unjustly treated.

"It is now evident that nothing will be done towards completing the canal until next spring, if then, and two hundred thousand dollars more of interest will accumulate in the meantime. This is wrong. It appears to be

adopting the policy of "saving at the spigot and losing at the bunghole." We are waiting for a cheaper contract, while we are losing in interest double the amount which we can hope to save by the cheap bargain. We wish the work to cost as little as possible, if it be completed at the expense of the State, and therefore desire to see it progressing, the procrastinating policy being ruinous.

"Col. Abert, in behalf of himself and others, asked leave to enter upon the proceedings of this day the following objections thereto, to be printed with the proceedings:

"1st. Because the meeting has refused the customary and just course of referring the matter in controversy in these resolutions, to the investigation and report of a committee.

"2d. Because the decision upon these resolutions is evidently made upon a one-sided report, from one of the parties involved, namely, the directors—a report which can be considered in no other light than that of a justification and defence of one party.

"3d. Because we believe that report to contain partial and erroneous inferences, personalities and harshness, eminently bearing upon the character and character and conduct of one of the parties, a report, which is, in fact, a defence of the directors, from themselves; and an attack upon the president, who was absent when said report was written and submitted to the stockholders.

"4th. Because we believe these matters require the investigation and opinion of an impartial and disinterested tribunal, namely, that of a committee of stockholders; without which course a just and impartial exhibition of the matter before the stockholders will not be in their possession.

"5th. Because that report from the directors brings new matters to the knowledge of the stockholders, not before brought to their knowledge; matters requiring deliberate and impartial investigation before a just decision upon them can be had.

"6th. Because from the personal explanation made this morning, August 17th, by the president, (who arrived last night,) we are the more convinced that investigation and report by a committee is necessary.

"7th. Because there is an application from the president, (which has been brought to the notice of the meeting this day) desiring that the matter may be referred to a committee to report at an adjourned meeting, and that he may be allowed an opportunity to be heard in his defence and justification. (Signed)

JOHN J. ABERT, (U. S. proxy.)
M. ST. CLAIR CLARKE,
ROBERT H. MILLER, (as proxy for corporation of Alexandria.)
CASPER W. WEVER,
SAMUEL BURCHE."

*August 17th*, 1843.

"The undersigned did not affix his name to the above protest, because he was disinclined to ask courtesy at the hands of those who had refused justice.

"The appointment of a committee, asked for by the representative of the United States and others was refused by the agents of Maryland, because they intended to return home the next day, and had not time therefore for an investigation: and the resolutions offered by the said agents were not discussed (so far as the undersigned was concerned) because he saw that the case was prejudged already; that the resolutions themselves were intened to carry out what it was admitted had been aimed at more than one month earlier, and before the contract referred to them had been entered into.

"For these reasons and more, the undersigned, at the moment of voting, made his verbal protest against the action of the agents of Maryland as *hasty and inexpedient.* He does so and in the same words still.

J. H. ALEXANDER."

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For the American Railroad Journal, and Mechanics' Magazine.

## CROTON WATER PIPES BURSTING.

We often hear of the main pipes, and also the house or service pipes bursting, by the great pressure of the water, and the public are not informed sufficiently on the subject. We are told, "that suddenly shutting off the water, is very likely to burst the pipe." In this "age of reason," we can generally trace cause and effect, and as we can in this instance, we will first make an assertion, and then endeavor to prove it.

"The water that runs through the pipe in this city, by its own motion given, by the head at the reservoir, can be made to burst almost any pipe through which it is allowed to pass with its full force, by stopping the motion of the water instantaneously, provided the pipe is long enough." We will now endeavor to prove the assertion; therefore we will say that a body of water is noncompressible, as much so as steel, or any other metal we now know of; we will set the water in motion, in a pipe whose length is represented by 1, the weight of the water in the pipe as 1, which strikes when in motion with that force, on shutting off suddenly. The pressure or power of the Croton water on the square inch we will also assume as 1, and the *motion* of the water also 1, (this is done to make it plain to all,) we will now take a pipe whose length shall be 100, it will contain *one hundred* times the weight of water, with the pressure the same and the motion of the water the same; now should the stop-cock of this pipe be shut, the motion of the water with the same rapidity will cause 100 times the strain acting to burst the pipe, and the length of the pipe may be increased until the power is so great as to burst pipes any number of times thicker than those which now sustain the pressure of the Croton water.

Though the service pipes may be ten times as strong as the main pipes, yet the stronger pipe will burst first, because the motion of the water is but slightly affected in a 12 inch main, by a small stream of water being taken from it, even with great rapidity.

Say a 12 inch main is supplying a ¾ pipe, the water in the 12 inch main will run or move 1 foot while the water in the ¾ pipe will run or move over 311 feet, thus conclusively showing that if the pipe is burst by the motion of the water being suddenly checked, the ¾ pipe must be 311 times as strong as the 12 inch main, showing most conclusively that *no established strength of pipe* can do our citizens justice.

Proportion is the beauty of these arrangements which is always varying under these circumstances according to the length of the pipe and the mode of stopping the current of water.

This requires some very matured plan to prevent those who take the water into their houses, through a long pipe, being very seriously troubled

by their pipes bursting. Many may think that they are safe because their pipes stand the pressure of the Croton water, but practice has proved that a succession of blows in a pipe from what is called "the water hammer" will burst a pipe after it has been in use for some years.

You will hear from me again in your next number.

*New York, August*, 1843. CIVIL ENGINEER.

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WESTERN RAILROAD—THROUGH FARE, REDUCED.

The competition that has grown up between this road and the river and sound navigation, it would appear by the following extract of a letter from an agent of this road, has induced the directors to reduce the *through* freight on flour to 20 cents per barrel. We have been informed, that with the new engines the company are procuring, that they can carry a barrel of flour with profit, at 12½ cents. It will be seen that all a railroad wants, is sufficient business to insure cheap rates of transportation.

The Western and the Worcester railroads are undoubtedly well constructed, but the heavy grades on the former, of 80 feet to the mile, with a rise of 1480 feet above tide in the short distance from the Connecticut river to the summit, with another summit between Springfield and Worcester of 900 feet, adds greatly to the expense of transportation, yet we find the nett earnings the first year on the whole line from Albany to Boston, 200 miles, at about 4½ per cent. The road, too, is in its incipient state. The directors, we will add, are learning their lesson, so to "fix the rates of transportation at low prices as to command freight, with an increase of nett income."

If flour can be transported 200 miles over grades of 60 to 80 feet for 11 miles for 20 cents per barrel, we do not see any difficulty in constructing a railroad from Buffalo to the Hudson, on a level or descending line, so as to carry it at the rate now charged by the State for tolls, to wit, 38½ cents per barrel. If this can be done at a profit, and we do not doubt it, would it not be well to lay a track of *good edge rails* from Buffalo to the Hudson instead of enlarging the canal. If properly located and constructed, a substantial road, with a double track, need not cost to exceed nine millions of dollars.

We think it can be demonstrated, that with a railroad equal in construction to the Western, the Philadelphia and Reading, or the Boston and Lowell, the tonnage that now floats on the Erie canal can be transported by railroad at rates cheaper than the prices now charged on the Erie canal, provided the railway has half the business. It certainly can be done with the addition of the immense number of passengers passing this thoroughfare. Let us look at it. A calculation like the following, may be a safe one.

The tonnage floating on the Erie canal the last year exceeded 600,000 tons, say that two-thirds or 400,000 tons would equal the average of through tonnage for the season of seven months. Five trains, daily, would carry this tonnage at a handsome profit, at $4 per ton, from lake Erie to the Hud-

son. This would yield for *freight*, $1,600,000

With respect to *passengers*, it is not extravagant to estimate that calculating the *way* with the *through* passengers, that they would equal, if not exceed 100,000 per annum, paying from Buffalo to the Hudson. We think it will be double this number. At the moderate rate of $6 for each through passenger, we have 600,000

$2,200,000

If we allow the liberal rate of 50 per cent for expenses, and to keep the road in perpetual repair, we have $1,100,000 as the profit on an investment of $9,000,000 for a double track. J. E. B.

"I send you a statement of the rates for flour on the Western road:

| | | |
|---|---|---|
| "From Greenbush to | Pittsfield | 27 cents." |
| " " | Dalton | 30 " |
| " " | Hinsdale | 32 " |
| " " | Becket | 33 " |
| " " | Springfield | 33 " |
| To any station east of | Springfield except Boston | 34 " |
| To Boston | | 20 " |

## CANAL STATISTICS.

From the Albany Argus of 12th August, we take the following comparative statement of the business of the Erie canal for five years, to 1st August, each year.

"Comparative statement of flour and wheat shipped at Buffalo, Black Rock and Oswego, and also of the quantity arrived at tide water to 1st August.

| | Shipped at Buffalo, | | at Black Rock, | | at Oswego. | |
|---|---|---|---|---|---|---|
| | Flour, bls. | Wheat, bush. | Flour, bls. | Wheat, bush. | Flour, bls. | Wheat, bu. |
| 1839, | 158,681 | 431,530 | 29,366 | 2,183 | 56,672 | 54,077 |
| 1840, | 540,984 | 210,812 | 33,412 | 3,094 | 46,358 | 36,294 |
| 1841, | 367,154 | 386,171 | 50,052 | 27,925 | 35,742 | 40,958 |
| 1842, | 278,697 | 386,475 | 43,677 | 16,263 | 42,490 | 5,187 |
| 1843, | 435,120 | 737,347 | 39,018 | 10,994 | 61,577 | 37 355 |

| | Arrived at tide water. | |
|---|---|---|
| | Flour, barrels. | Wheat, bushels. |
| 1839, | 324,624 | 108,028 |
| 1840, | 628,850 | 214,451 |
| 1841, | 624,624 | 117,090 |
| 1842, | 535,894 | 230,926 |
| 1843, | 672,803 | 191,051 |

Taking flour and wheat together (the wheat being reduced to barrels of five bushels) the shipments at Buffalo, Black Rock and Oswego, and the arrivals at tide water to the 1st August, are as follows, viz:

| | Shipments, equal to | Arrivals, equal to |
|---|---|---|
| 1839, | 342,277 bbls. | 346,224 bbls. |
| 1840, | 478,795 " | 671,740 " |
| 1841, | 544,719 " | 648,042 " |
| 1842, | 424,458 " | 582,081 " |
| 1843, | 690,854 " | 711,013 " |

The above statement shows that the arrival in each year at tide water to

the 1st August, since 1838, has exceeded the import from western States as follows. Of the arrival at tide water there was

| | From western States. bbls. | From this State. bbls. | Total. bbls. |
|---|---|---|---|
| 1839, | 342,277 | 3,947 | 346,224 |
| 1840, | 475,795 | 195,495 | 671,740 |
| 1841, | 544,719 | 103,323 | 648,042 |
| 1842, | 424,458 | 157,623 | 582,081 |
| 1843, | 680,854 | 20,159 | 711,013 |

These excesses of arrival of flour at tide water in each year to the 1st August, over the imports from western States to the same time, represent the surplus of our own State, coming to tide water in each year.

*Merchandize.*—Statement of the tons (2000 lbs.) of merchandize sent from tide water, and of the quantity received at Oswego, Black Rock and Buffalo, to 1st August, viz:

| | Shipped at Albany and West Troy. | Oswego. | Delivered at Black Rock. | Buffalo. |
|---|---|---|---|---|
| 1839, | 59,779 | 5,230 | 58 | 20,789 |
| 1840, | 43,255 | 2,766 | 47 | 10,139 |
| 1841, | 55,972 | 5,174 | 29 | 13,681 |
| 1842, | 39,258 | 4,189 | 28 | 10,652 |
| 1843, | 44,666 | 3,899 | 5 | 14,980 |

In connection with the preceding valuable and interesting statements, we repeat the account (given on Monday) of tolls received on all the canals of this State, and of the lockages at Alexander's lock, three miles west of Schenectady, to the 1st August, viz:

| | Tolls. | Passages at Alexander's lock. | |
|---|---|---|---|
| 1839, | $761,423 | 10,646 | |
| 1840, | 716,526 | 11,555 | |
| 1841, | 912,224 | 13,486 | |
| 1842, | 750,951 | 10,090 | |
| 1843, | 858,485 | 9,668 | |
| The increase over last year is | | | $107,534 |
| Of this increase there is at Buffalo | | 68,459 | |
| " " | West Troy | 28,424 | |
| " " | Albany | 6,368 | 103,251 |
| Leaving for increase at all other offices, | | | $4,283 |

The $103,251 represents the increase of produce from, and merchandize to, western States, by the way of Buffalo. The $4,283 represents the increase over last year in the *home business*, or business of this State."

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PROFESSOR MORSE'S ELECTRO MAGNETIC TELEGRAPH.

We have been recently favored with an opportunity of witnessing some remarkable experiments preparatory to the construction of the telegraphic line between the cities of Baltimore and Washington. Wires to the total length of 158 miles having been prepared, it was thought proper by Professor Morse that this unusual length of wire should be used as a test of the powers of his system and also as a means of determining such points of scientific inquiry as might depend upon the employment of apparatus of such remarkable magnitude.

Several scientific gentlemen were present—Prof. Renwick of Columbia

college, Prof. Draper of the New York city University, Prof. Ellet of the south Columbia college, J. R. Peters, C. E., and Drs. Fisher and Gale, assistants to Prof. Morse. The arrangements from their temporary character, were not intended to show the perfect working of the finished telegraph. The powerful battery employed was operated under the disadvantages of imperfect insulation and the dampness of the earth above which they were supported—this was feelingly demonstrated by the liberal supply of shocks given in every direction by the slightest contact. Notwithstanding the disadvantages the results were such as to afford the utmost gratification to all present. The battery employed was of the form known as "Groves' Constant Battery," with plates of platinum in pure nitric acid, and amalgumated zinc in dilute sulphuric acid—the two liquids separated by a porous diaphragm. One hundred of these pairs were sufficient to work the magnets through the whole 158 miles of wire, and that too, in the space of a scarcely appreciable fraction of a second of time. A portion of this interval was consumed in overcoming the resistance of the spring attached to the moving point and the friction of the joint, so that as far as speed of communication is concerned we may safely say that the action is instantaneous through this length of wire. This result although in accordance with the known laws of electric action, was yet, gratifying as affording a confirmation of them when applied to an "extreme case." The use of a larger number of pairs, of course increased the power of the magnets.

A series of experiments was then made to ascertain the resistance to passage of the electric current by various lengths, of from 2 to 158 miles of wire. The result was again in accordance with what had been predicted. This resistance increases rapidly with the first few miles, and less and less rapidly afterwards, until for very great lengths no sensible difference can be observed. This is a most fortunate circumstance in the employment of electro magnetism for telegraphic purposes, since, contrary to all other modes of communicating intelligence, the difficulty to be overcome decreases in proportion to the distance.

Several other experiments, suggested by the unusual opportunity of a very large battery, were then made—and one circumstance throughout the whole time consumed, several hours, was worthy of note—we refer to the remarkably constant effect of the battery. This is one of the advantages of recent improvements, since the apparatus formerly in use, was subject to a very rapid and permanent loss of power.

Since these experiments were made, we have seen in the Glasgow "Practical Mechanic and Civil Engineers' Magazine," a description of the telegraph of Messrs. Cooke and Wheatstone—a more recent invention than that of Prof. Morse, as may be seen by a reference to our number containing the report of the committee in congress, on the bill giving an appropriation for a trial of Prof. Morse's plan. Notwithstanding the early date of this invention, 1832, the article in question gravely asserts that the history of electro magnetic telegraphs dates from the year 1836, although the prior-

ity of invention by Prof. Morse, was known to most of the scientific men of Europe.

An attentive examination of the two plans, will soon convince any one understanding anything about such matters, that they never can become rivals. The telegraph of Cooke and Wheatstone, although similar, to that of Morse in principle, is totally different in its applications. In the English telegraph a number of signs to denote the letters of the alphabet or the signals of an arbitrary code are *exhibited*, not written down. They may be compared to the manual alphabet of the deaf and dumb, with this exception, that three successive signs are required for some letters, and the dial must be attentively watched or the signals are lost and cannot be recovered unless by a second transmission. In the American telegraph the intelligence is written down, and anything expressed by ordinary written language, letters, figures or cyphers, may be instantaneously transmitted and recorded, even in duplicate, triplicate or quadruplicate, if desirable. The absence of an attendant, therefore, makes no difference in the reception of intelligence. The American invention has the advantage, also, in point of expense and from several ingenious improvements in the mode of preparing and laying the wires, we feel assured that its liability to derangement is far less than that of the more costly English telegraph.

In its most elementary form the apparatus of Cooke and Wheatstone has been in use upon several railroads, and if the power of transmitting but two signals, as on the Blackwall railway, is worth the original outlay, the possession of an unlimited communication for the purposes of the company or of individuals, must certainly be worth much more, and yet the cost is in fact less.

A single track of railroad of any length can be made as effective and as safe by means of this auxiliary, as any double track can be, and this too, at an original outlay of about the sum required annually to keep a track in repair. The advantages to railroads of this important invention can easily be understood by those familiar with railroad management, and if to these we add the profit to be derived from the transmission of intelligence, we certainly think there is ample inducement for its employment upon every railroad in the United States.

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RAILROAD SUCCESS.

Who can say that railways are not profitable? The Attica and Buffalo railroad, commenced two years since, has been finished and put into operation, at the very moderate cost below named. A semi-annual dividend of 3 per cent., too, is declared for the first six months. We are sorry that such enterprize and such a reward should not belong to the citizens of our own State. But if New England builds our railroads it is no more than fair that she should be handsomely remunerated.

*Attica and Buffalo Railroad.*—The whole length of the road, including branches and turnouts, is 32 miles, constructed in a good substantial man-

ner at a total cost of $259,366. The personal property owned by the company consists of three locomotive engines, six first class passenger cars, five second class passenger cars, two baggage cars, one mail car, twenty-five freight cars, and cost $31,307.

The receipts of the road from passengers, exclusive of pay for carrying the mails, for the four weeks ending August 20, were $6,310 94. Whole number of passengers carried during those four weeks, 9630. The current expenses for running and repairing cars and road in the same time was $1,305 76. The directors have just declared a semi-annual dividend of 3 per cent.—*Buf. Com. Adv.*

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REPORT OF THE ENGINEER IN CHIEF OF THE GEORGIA RAILROAD AND BANKING COMPANY.

To the Hon. John P. King, President Georgia Railroad and Banking Company:

SIR: An unavoidable absence from the State until within a few days past, will prevent me giving as detailed an account of our operations since the last convention, as I had intended. I trust, however, that the stockholders will be able, by a careful examination of the numerous statements accompanying this report, to satisfy themselves as fully of the condition and state of their affairs as though I had been more comprehensive in my remarks.

The extension of our road beyond Madison, so frequently agitated, has been commenced during the past year, and it is to be hoped that the exertions of the company to continue its progress to the State railroad, will be unremitted. There never was a period more propitious for the execution of such work than the present, and by a continued and vigorous prosecution of the enterprize, we shall be enabled to witness its entire completion, in time to meet the tide of prosperity which there is now every indication, will shortly dawn upon our country.

There is no section of the Union, having equal local advantages, where land can be procured on such favorable terms, as in the extensive region to be drained by the Western and Atlantic railroad. The expense of transporting produce to market, has heretofore retarded its growth; but as this difficulty will shortly be overcome by the completion of a continuous line of railroad from the sea-board, stretching around ours 350 miles into the interior, we may expect a rapid increase in her population and wealth. Notwithstanding the sparseness of its present population, a large share of our business is now derived from this region, which, if we should fail to connect with the State railroad, will in a great measure, be lost to us. We shall then be thrown back for support upon the trade of the old counties from whence Augusta derived her prosperity. These, though originally possessing a bountiful soil, have, by a false system of agriculture, become exhausted, and are now unable to afford us a large transportation. The opening of fresh counties in the west and north west section of the State, has hitherto sustained the prosperity of this city; but if we should pause in our progress, these new streams will be diverted to other channels, and as a necessary consequence, she must continue to decline.

Our contracts for grading, terminate near Covington, about 23 miles above Madison. From this point, we think, that if the road should not be farther extended, we shall be able to command, in consequence of the present superiority of the Augusta market, and the choice of those on the sea-board, which our route presents in an eminent degree, the transportation of the larger portion of the cotton produced by the counties west of us. It will also give us an important advantage in the transportation of the mail and passengers, and enable us to obtain the much desired object of traversing our road with the mail train down, for the most part, by day light.

Our present contracts end at a point convenient to pass from thence, either through Covington, or by a more direct route, leaving it about one mile to the left. The distance saved by this cut-off, is seven-eighths of a mile, and the cost of graduation, etc., lessened by it $17,000, to which should be added for the cost of the superstructure on the distance saved, and the capital on the annual amount expended to sustain the increased length of road, and the consequent additional cost of transportation thereon, $14,000; making the whole actual saving, $31,000.

Under a contract with the Middle Branch railroad company, we agreed to pass through the village of Covington; the charter of that company having expired, the legal binding of that contract has ceased; but the moral obligation to fulfil it, is still in force, and it appears to me that it can only be removed by the consent of the individuals with whom the contract was made, or their assignees, voting in proportion to the interest held by each in the company. Whether efforts to obtain their consent shall be made, is referred to the consideration of your board.

The estimated cost of preparing the road between Madison and Covington (26 miles) for the reception of the superstructure, is $215,000, including the purchase of the right of way. Of this sum, $170,000 will be provided for by the Newton county stockholders, under an arrangement with them to work out their indebtedness for stock, upon terms that were considered equitable and just between the parties. The remainder will have to be met by cash payments. The grading and bridging on the line beyond Covington, including the right of way, is estimated, at the present reduced price of labor, at $175,000, making the cost of preparing the road bed on the entire extension of the line to the Western and Atlantic railroad, $390,000.

The superstructure will vary according to the plan adopted, and the contingency of the admission of the iron free of duty, from $275,000 as the minimum, to $475,000 as the maximum cost. From recent information, I entertain little doubt, but that the duties on the heavier description of iron rails, will be remitted by the next congress, in which event the cost of the superstructure laid with a T rail, will not at the present price of iron, exceed $370,000. The whole cost of the road, 68 miles in length, would then stand thus:

| | |
|---|---|
| Grading, bridging and right of way, | 390,000 |
| Superstructure, | 370,000 |
| Superintendence, etc., | 30,000 |
| Total, | $790,000 |

equal to $11,600 per mile, which is unusually low, considering the broken nature of the ground, encountered in passing the valleys of the Alcovy and Yellow rivers. The first with a bridge of 1000 feet in length, and 72 feet above the water, and the other 400 feet long, and 65 feet high.

The upper half of the road, will traverse for more than 30 miles, a ridge presenting throughout its course, a remarkably even profile, the average cost of grading upon which, will not exceed $3,000 per mile. This part of the route, encounters the whole of the far-famed "difficulties" presented by the "Stone mountain and its numerous spurs."

The grading and bridging now in progress, will be completed in about 15 months, and the remainder of the line can be executed, if commenced during the ensuing winter, as rapidly as the superstructure can be brought up with it.

The business of the road this year, has in the aggregate, exceeded that of last year, $23,771 31, the increase on freight, is $32,185 18, and on mails, $2,029 26, while for passengers (and some other small items,) there has

been a falling off of $10,443·13. The causes that have produced this decrease, are traceable solely to the extraordinary depression in the price of the staple of the country. The loss has been nearly uniform at all the stations, except one or two which have not fallen off, in consequence of known local causes.

It will be perceived, however, that there has been an increase in way passengers, (or those passing between intermediate stations,) the receipt from whom, this year, are more than 10 per cent. of the whole travel. The revenue from this source, for the week ending April 1, 1841, was only $3,505·30, for the year ending April 1, 1842, it was $5,256·18, and for the present year, it is $6,510, exhibiting a uniform and gratifying increase each year, notwithstanding the inconvenience which such travel is placed under in consequence of our night schedule.

Since the close of the year, our books show an increase in our receipts for both passengers and freight, over the corresponding months of last year. In up freight the gain is nearly two-fold, and it is in a great measure derived from our Tennessee and Alabama customers, who if our road is not pushed forward, will unquestionably seek another channel for the transportation of their goods.

Some efforts have been made, which have not yet proved successful, to organize a ticket by which a reduction in the rates of passage could be effected on travel going entirely through, from Montgomery to Baltimore, so as to enable us in connection with our greater speed, to compete with the boats on the Mississippi. In consequence of the numerous interests to consult, the arrangement has not yet been perfected, but it is believed that most of the difficulties have been removed, and the experiment will, in a short time, be fairly tried. The extension of the same system, through to New Orleans, would be desirable, but as there are no regular packet boats, at present established on the Alabama river, that run at all seasons of the year, a connection could not be formed, immediately, that would be satisfactory.

Our rates of freight on cotton were reduced last season, to an average of 40 cents a hundred pounds, per 100 miles. This rate, I believe, gave to us the largest nett profits that we could have derived from the crop. A lower rate would possibly have given us more business, but we could not have gained a sufficient number of bales by a further reduction, to cover the loss that would have been sustained upon that carried. Instead of future reductions to any extent, it has been suggested that we give to the customers of the road, some conditional right of passage to Augusta on more favorable terms than the ordinary travel.

It is proposed to revise during the ensuing summer, our tariff on up freights. A reduction may be made on some articles, but our rates are conceived to be, generally, low enough. There is no part of the duties connected with the management of railroads, that require as much consideration as the charges on freight. While too high rates will in a short time lessen the amount of the receipts of the road; on the other hand, a very reduced scale, may add greatly to its business, without a corresponding increase in the nett profits. A just medium is to be observed, and can only be obtained by a full knowledge of the nature of the transportation expected, and the sources from whence it is to come, together with the controlling circumstances calculated to divert its passage from over the road. The knowledge obtained on this subject, during the time the road has been in operation, we trust will enable us to fix a scale which will give satisfaction to our customers, and at the same time, meet the paramount interest of the stockholders.

The following summary statement, will show the business of the road,

and the expenses incurred in working it, during the year ending on the 31st of March last. The usual statements giving the business and expenses in detail, will be found among the papers accompanying this report:

| | | | | |
|---|---|---|---|---|
| | | Cr. | | |
| By amount for passengers up, | | 30,637 84 | | |
| " | " down, | 31,297 46 | | |
| " | " extra trips, extra baggage, lots of negroes, etc., | 1,105 51 | | |
| " | " freight up, | 69,591 43 | | |
| " | " " down, | 84,574 07 | | |
| " | " " between stations, | 725 15 | | |
| " | " premium and rents, | 913 00 | | |
| " | " transportation of mails, | 29,182 48 | —248,026 | 94 |
| | | Dr. | | |
| For expenses of conducting transportation, | | 25,170 02 | | |
| " | " motive power, | 30,220 34 | | |
| " | " maintenance of way, | 44,684 34 | | |
| " | " " cars, | 9,744 37 | —109,819 | 07 |
| Leaving nett profits, | | | $138,207 | 87 |

Our contract with the post office department has been renewed, at the same rate of compensation per mile, received under the old agreement, commencing the new service on the 1st of July next.

We proposed to transport the great mail, starting from either end of the road, at such hours as the department might designate, at an average speed at night of 11 miles per hour, for the annual compensation of $300 per mile, or at $237½ per mile, leaving Madison at 3 P. M. The first proposition was rejected, on the ground that the funds of the department would not justify an increase in railroad compensation, beyond the old price, ($237½ per mile,) and the second was finally acceded to, by changing the hour of starting from 3 to 5¼ P. M. By the completion of our road to Covington, however, we shall be able to change the schedule so as to reach Augusta before midnight.

The decision of Mr. Kendall, in relation to railroad mail compensation, was to allow $237½ per mile, to such roads as surrender the control of their hours. The present post master general, has so far deviated from this rule, as to allow this price to all railroads on the great mail route, indiscriminately.

Under this arrangement, the S. C. C. & R. R. Co. receive for a day schedule of only 13½ miles per hour, the same rate allowed to us, for night service both ways. In Mr. Kendall's decision there was some fairness, but in the present, there is none.

Under the schedule adopted between Washington and Madison, the mails will arrive with much more regularity than formerly. If failures occur, they must arise chiefly from the late arival of the boats at Charleston, which could be prevented in a great measure, by a later hour of departure of the cars from that city; there being ample time west of it. In fact, many of the failures which have heretofore taken place, may very properly be placed to the account of the S. C. R. R. Co., whose adherence to an early departure from Charleston, has been an important cause of the derangement in the line, and a serious inconvenience to their neighbors, which will be only partially overcome by their consenting to leave at 9 instead of 10 o'clock A. M.

Our motive power has been greatly improved, and it is now capable of performing 50 per cent. more work than we have at any time had occasion

for. Under these circumstances, I did not hesitate to embrace an offer from the State of Georgia, to purchase from us the locomotive Florida, which has since been delivered upon the Western and Atlantic railroad.

Although the distance run (152,873 miles,) by all the locomotives during the year exceeds that of the previous year, only 353 miles, yet we brought down with them 23,000 more bales of cotton, showing an increased efficiency in their performance, of 50 per cent., which however, is partly to be accounted for, from the circumstance of being able to obtain more frequently, full loads. The expenditures in this department, notwithstanding the improvements of machinery, which are still progressing, is but $30,220 34, about the same as last year. The ordinary repairs of engines, were $7,790 90, and extraordinary repairs, but $76 00, the last occasioned by an accident to the night line. The saving in this item, compared with that given in previous reports, exhibits clearly the advantages of a slow speed for freight, and a fixed schedule to run to by freight, as well as passenger trains.

One of our small locomotives, (the Tennessee,) has been altered to Baldwin and Whitney's patent 6 wheel freight engine, and now weighs about 11 tons. It ran but a few trips, after it was received, before it met with an accident, caused by the weakness of the shackle pins, which are being repaired by the patentees, upon a more substantial plan. The performance of the machine while running, was entirely satisfactory. It drew up our steepest gradient, 37 feet per mile, a gross load of 240 tons, exclusive of engine and tender. This improvement if successful, and I now entertain but little doubt on the subject, will be of great importance to railroad companies, especially to those who have laid down the ordinary plate rail.

We have erected an iron foundry adjoining our machine shops, which has been leased for an interest on its cost, under a contract with the individual renting it, to execute our castings at 1¼ cents per pound. By this arrangement, we get our old wheels converted into new ones, for about $7 00 each, which will effect a considerable saving in our future outlay for cars. We have succeeded in giving the wheels as deep and uniform a chill as those obtained from the best manufactories at the north.

The expense of maintaining the road, has according to our expectations, been greater than any previous year, and probably will not again reach the present amount. Next year it will be considerably less, if nothing extraordinary should occur. The average cost per mile, is $303.

The accounts for next year, will exhibit a considerable saving in all the branches of the business of the company, owing to the reduction in the price of labor, provisions and materials, together with the improved condition of our machinery.

Our nett profits this year, are about 6 per cent. upon the cost of the *whole road*, and I cannot think that they will, at any time, be much less than this rate. The returning prosperity of the country, would lead us to hope that they would soon greatly exceed it; a hope which is only clouded by the anticipated interference of rival improvements.

Respectfully submitted by your obedient servant,

J. Edgar Thompson,
*Chief Engineer and general agent.*

*Statement of the Yearly Expenses incurred for working the Georgia Railroad, from April 1, 1839, to April 1, 1843.*

| | Year ending April 1, 1840. | | Year ending April 1, 1841. | | Year ending April 1, 1842. | | Year ending April 1, 1843. | |
|---|---|---|---|---|---|---|---|---|
| CONDUCTING TRANSPORTATION. | | | | | | | | |
| Stationery and printing, | 589 55 | | 475 04 | | 777 56 | | 585 69 | |
| Loss and damage, | 1,666 93 | | 738 67 | | 1,909 18 | | 382 34 | |
| Incidentals, | 1,101 31 | | 883 45 | | 1,624 68 | | 1,866 08 | |
| Oil and tallow for cars, | 288 61 | | 182 78 | | 402 72 | | 410 97 | |
| Provisions, clothing, etc., for negroes, | 4,041 57 | | 2,593 98 | | 2,849 42 | | 2,862 07 | |
| Expenses of mules, Warrenton branch, | 360 25 | | 799 43 | | 1,002 62 | | 501 10 | |
| Expenses of horse car, Athens branch, | | | | | 583 34 | | 2,336 33 | |
| Wages, laborers, | 4,522 59 | | 2,355 11 | | 2,022 24 | | 3,958 23 | |
| Agents and clerks, | 7,467 89 | | 7,356 39 | | 8,742 88 | | 9,329 42 | |
| Conductors, | 3,927 81 | | 2,484 75 | | 2,024 83 | | 2,663 79 | |
| Work done by car factory, | | | | | 220 50 | | 152 50 | |
| Work done by machine shops, | | | | | 480 00 | | 31 50 | |
| | | 23,966 51 | | 17,869 60 | | 22,699 97 | | 25,170 02 |
| MOTIVE POWER. | | | | | | | | |
| Stationery and printing, | 59 17 | | 16 25 | | 13 08 | | | |
| Expenses of water stations, | 3,009 40 | | 2,480 98 | | 2,518 11 | | 2,061 12 | |
| Incidentals, | 70 82 | | 27 95 | | 329 49 | | 184 62 | |
| Fuel, | 6,839 24 | | 5,402 87 | | 7,186 61 | | 6,405 12 | |
| Oil and tallow for engines, | 3,108 84 | | 1,177 54 | | 1,538 73 | | 1,411 34 | |
| Ordinary & extraordinary rep's to eng's, | 6,403 38 | | 6,792 19 | | 9,610 28 | | 7,866 90 | |
| Improvements to engines, | | | | | | | 2,288 00 | |
| Engine drivers and firemen, | 7,523 73 | | 4,715 13 | | 7,079 33 | | 7,151 14 | |
| Provisions, clothing, etc., for negroes, | 1,503 59 | | 2,039 07 | | 1,735 42 | | 2,852 10 | |
| | | 28,518 17 | | 22,652 88 | | 30,011 05 | | 30,220 34 |
| Carried over, | | 52,484 68 | | 40,522 48 | | 52,711 02 | | 55,390 36 |

*Statement of the Yearly Expenses incurred for working the Georgia Railroad, from April 1, 1839, to April 1, 1843,* (*Continued.*)

| | Year ending April 1, 1840. | | Year ending April 1, 1841. | | Year ending April 1, 1842. | | Year ending April 1, 1843. | |
|---|---|---|---|---|---|---|---|---|
| Brought forward, | | 52,484 68 | | 40,522 48 | | 52,711 02 | | 55,390 36 |
| MAINTENANCE OF WAY. | | | | | | | | |
| Mens' wages, | 12,514 12 | | 12,103 67 | | 19,549 58 | | 18,322 73 | |
| Supervisors, | 1,999 94 | | 1,699 96 | | 1,733 29 | | 2,724 23 | |
| Provisions, clothing, etc., for negroes, | 2,174 69 | | 1,592 35 | | 2,703 06 | | 1,764 62 | |
| Incidentals, | 220 26 | | 180 49 | | 524 99 | | 809 49 | |
| Tools, | 414 07 | | 377 56 | | 826 99 | | 399 78 | |
| Iron and spikes, | | | | | 550 47 | | 1,969 66 | |
| Wooden rails and cross ties, | 1,401 17 | | 5,446 38 | | 11,382 80 | | 16,046 74 | |
| Repairs of culverts, | | | | | | | 376 88 | |
| Work done by car factory, | | | 436 20 | | 511 16 | | 795 70 | |
| Work done by machine shops, | | | | | 910 17 | | 1,474 51 | |
| | | 18,733 25 | | 21,836 61 | | 38,692 51 | | 44,684 34 |
| MAINTENANCE OF CARS. | | | | | | | | |
| Ordinary repairs, | 4,936 30 | | 4,725 20 | | 3,660 00 | | 2,144 37 | |
| New baggage car, | | | | | | | 1,050 00 | |
| Renewal of wheels, | | | | | 1,167 50 | | 3,098 63 | |
| Renewal of Axles, | | | | | | | 351 37 | |
| New platform car, | | | | | | | 2,500 00 | |
| Extraordinary repairs, | 480 00 | | 189 15 | | 1,287 00 | | 600 00 | |
| | | 5,416 30 | | 4,924 35 | | 6,114 50 | | 9,744 37 |
| | | $76,631 23 | | $67,283 44 | | $97,518 03 | | 109,819 07 |

For the American Railroad Journal and Mechanics' Magazine.

ON A NEW APPLICATION OF RAILWAYS.—BY ELLWOOD MORRIS, CIVIL ENGINEER.

It is well known that prior to the introduction of the modern railway system, cities were chiefly furnished with provisions, from a space covered by the revolution of a very limited radius, whose length was determined by the distance which horses could travel within a few hours; while but very moderate supplies indeed, were ever drawn from a greater distance than a days' drive.

An immediate result of the greatly augmented speed of travel, consequent upon the construction of any modern railway leading from a city into the interior of the country, is a direct and considerable extension of the surface, capable of becoming with advantage, *tributary to the market of that city.*

The large augmentation of the surface of production, tributary to any market consequent upon a diminished cost and increased speed of transport, must inevitably have an effect upon the value of provisions there, and it will follow hence, that whenever the railway system shall be properly availed of for the supply of our cities, the selling prices of country produce in their markets, *must fall,* and their numerous inhabitants be thereby benefited.

This is but another phase of the important economical revolution, which the great iron roads of modern days, are gradually producing, in all that is in any way dependent upon the cost or time of carriage.

Upon the European railways, the highest advantages seem to have been derived from the facilities they furnish for the cheap and easy carriage, from great interior distances, of live stock and other provisions destined for the supply of the overgrown communities there assembled in the great cities.

Even in our own country their influence in the aspect referred to, is begining to be strongly, as well as beneficially felt, and one railroad corporation at least, has profited considerably by the establishment of a market train, regularly drawn, like other freight, by locomotive steam power.

We refer to the Camden and Amboy railroad company, the directors of which, in their elaborate report of 1840, upon the completion of their works, describe the success that has attended the establishment of a regular market train upon their railway, which has been the means of opening for the supply of the provision market of New York, a large district of country, practically inaccessible before.

In the report referred to, at page 11, we find the following statement:

"Two years since at the request of some market people in New Jersey, a line called *the pea line,* with two cars, was occasionally started from Camden to New York, with no other view or expectation than the accommodation of a very useful and respectable class of men. This line has steadily increased until it has become profitable beyond all expectation. During the past year, it has been running daily, sometimes taking with it as many as sixteen cars, laden at the appropriate season with peas, peaches, potatoes, as-

paragus, cabbages, live stock, and upon one occasion (as incredible as it may seem) *thirty tons of green corn!*"

The European railroads have been found extremely beneficial in the transportation of live stock, and other provisions to the great cities, which have thus been enabled to draw their supplies from a much larger surface of country, and consequently at a smaller price.

Since the completion of the Baltimore and Ohio railroad to Cumberland, extravagantly high prices can no longer be commanded for agricultural products on sale in the Baltimore markets; thus with the article of *butter*, it has been recently observed that whenever it becomes unusually high, large quantities are promptly sent down by the farmers beyond Harpers Ferry, and prices fall at once.

So strong indeed is the influence of this railway in regulating, and keeping down to a moderate standard, the market prices of Baltimore, that it has already become a subject of complaint, with those who, from the nearness of their position, have heretofore been able to hold a monopoly of the supply.

Other facts might readily be adduced, which in connection with the remarkable experience of the Camden and Amboy company, would show in a striking light the advantages which must follow the introduction of market cars upon railways, and will ultimately among other results, tend to soften the prejudices still entertained by some against railways as aristocratic monopolies, since by reducing the cost of the necessaries of life to all, they will recommend themselves in the strongest manner to a large majority of our population.

With the introduction of market trains upon railways, *provision depots* become desirable, and the first of these which has fallen under the notice of the writer, where provisions brought in railway cars are kept on sale, both wholesale and retail, is that lately erected in the city of Philadelphia in connection with the Columbia railroad, and opened in June of this year, under the denomination of the *car market*.

It is this new application of railways—*to the formation of a railroad market*—that it is proposed briefly to describe.

The idea of constructing a *railway market*, having been for some time entertained by Mr. Samuel Webb an intelligent and enterprizing citizen of Philadelphia, who foresaw the advantages that must flow from the transportation of provisions by the railways centering upon that city; he applied to the writer during the past year, to work out the practical details, and superintend the construction of *a car market house*, of which he furnished the outline.

This building has accordingly been erected; it was opened to the public in June last, and promises to be very successful.

The *car market* is 200 feet long, and 40 feet wide, it fronts on Schuylkill Seventh street north of Callowhill, its axis being parallel to the State railroad leading to Columbia, and 130 feet distant from the southern sideling.

In consequence of the position of the building, it was necessary to enter

it through the north flank by reversed curves, with a short tangent between: this is effected by turning out of the Columbia railway to the right, upon a curve of 80 feet radius and 51½° deflection, into a tangent running off obliquely at that angle; thence by this tangent 90 feet, and then by another curve of 80 feet radius and 51½° deflection, turning to the left we curve into the axis of the market house.

Through the centre of this building longitudinally, from end to end, a straight track of railway is laid, and to enable the empty cars to pass out without interference, a return track is provided, which by a radius of 48 feet turning 128½° of curvature, re-enters the oblique tangent before mentioned.

All of these curves are laid with a common railway superstructure, and though their radii are so very limited, they nevertheless answer their purpose satisfactorily.

The writer will here observe in passing, that for the ordinary entrance tracks of depots, a common railway superstructure, where all the wheels run upon their treads as usual, will answer very well when curved upon a radius of 80 feet, and of the numerous side tracks recently laid here, to accommodate the coal trade descending the Reading railway, nearly all the curves are ordinary railroad tracks, and in some of them radii of curvature of less than 80 feet, have been adopted without inconvenience.

The car market is near 37 feet wide in the clear, and the stalls are made to project out 8 feet, at every 16 feet lineal of the walls, forming recesses between, and leaving a central promenade of 21 feet wide, entirely unincumbered, except by the pillars which carry the second floor.

This arrangement allows ample space for purchasers, even when the central railway is filled with cars, and by means of the projecting stalls, furnishes a great developement of stall surface, for the exposure of provisions on sale.

The building is of stone, two stories high, and the second floor is destined in the course of time, to be also used for the sale of the lighter articles of marketing, which, brought to the market in cars, will then be elevated to the next story, by some convenient means.

Such is the outline of an enterprize which will probably form a prototype for others on a more extended scale, *since the idea acted upon seems to be a sound one, and must eventually have a very important effect, upon the provisioning of those cities, which by their railways, command the interior country.*

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RAILWAY COMMUNICATION BETWEEN PARIS AND THE NORTHERN PORTS OF FRANCE.

By the politeness of Mr. Joseph E. Bloomfield, we have received a copy of the report of Mr. Robert Stephenson to the directors of the South Eastern railway. The valuable information to be found in this document upon one of the most important lines of railroad in Europe, has induced us to give an abstract of portions of Mr. Stephenson's report.

In 1835 under the direction of the French government M. Vallee ex-

amined the whole of the northern lines of railway and reported fully thereon. The lines recommended by M. Vallee contemplated a route direct to Amiens and thence two diverging lines, one to Boulogne and another to Calais—two points of union with the Belgium railways were likewise indicated. Under the arrangements then proposed by government, negotiations were made with a Mr. Cockerill which were finally abandoned on account of the inadequate aid offered by the French government.

"The plan recently proposed by the minister of public works, and approved and authorized by the Chambers, consists of bringing the funds of government in aid of private enterprize, and should fair and equitable terms be obtained from government, there cannot be a doubt that such an arrangement will prove highly beneficial to the individual as well as to the country at large.

"The outline of the government proposition is this:

"They engage to purchase all the necessary land and construct the whole of the earth-work, bridges, and stations, leaving to the company the execution of the upper works of the railway, that is to say, laying the rails, chairs and ballasting, and to supply the whole of the carrying establishment, viz. locomotive engines, wagons, etc. For this expenditure the company are to work, and have the entire profits of the working of the line for a given number of years; at the expiration of which, on the purchase of the then existing stock at a just valuation, the government become the sole proprietors of the railway. It is further proposed, that if the company prefer executing the earth-work, bridges, etc., leaving solely to the government the purchase of all land required for the works, and the construction of the stations, the government will pay to them such sums as may be calculated to afford an ample profit for the execution of these works. The company will possess the entire control of the undertaking from the commencement, subject only, of course, to such laws as are expedient for the establishment of public security, and the maintenance of the public welfare. The lease, under these conditions, would, of course, be limited as before, and at the expiration of it the government become possessors upon the same terms."

The remarks of Mr. Stephenson upon the singular restrictions imposed upon M. Vallee are of sufficient professional interest to be given somewhat at length.

"Before taking up the detailed examination of M. Vallee's plans and sections, it is necessary that I should allude to one or two of the engineering instructions, which he appears to have received from the French government, and under which he seems to have acted in almost every case, and in many, if we may conclude from the tone of his remarks, against his own judgment.

"The restrictions I refer to are—

"1. That no curve should be made under 1,200 metres in radius.

"2. That no gradient should exceed 3 in 1,000, or, as it is expressed by English engineers, $\frac{1}{333}$, or about 16 feet a mile, and

"3. That all curves of small radii should be level.

"In deputing an engineer to examine a tract of country extending from Paris to Belgium, and to the ports lying contiguous to England, and embracing several marked and difficult physical features, it were hard to conceive instructions better calculated to fetter the free exercise of his judgment and prevent the results of his survey being practically useful, than those just laid down.

"Those instructions would no doubt compel him narrowly to study every feature of the face of the country, for with limitations of this kind, the designing a line of railway over so extensive a district, must necessarily prove a matter of extraordinary difficulty; indeed, so distinctly has this proved to be the case, that, in some of the lines laid down by M. Vallee, he has been driven to the necessity of abandoning, in a few instances, the letter of his instructions; and, in the projected line between Etaples and Boulogne, the increase of work occasioned by an adherence to his instructions, has been of so extensive and glaring a character, that he has felt himself called upon to allege two untenable reasons for that adherence, namely, the short distance along which the difficult features present themselves, and the necessity of decreasing the load of every train on its approach to this incline, should he establish it at 5 instead of 3 in 1000; in fact, such deviations have only been applied to the sections, where the surface of the country actually defied the application of the government regulations, except by the adoption of such expedients, as would have appeared, when developed, obviously preposterous. The nature of the country having in such cases proved unmanageable under those restrictions, and consequently having thrown the engineer upon his own resources, it is to be regretted, that throughout his examination he did not keep sufficiently in view, and more frequently and specifically point out in his report, the results which would have attended any other mode of treating the section of country, which the line was proposed to traverse; on the contrary, he seems even to have alluded to a deviation from the strict conformity with his instructions only when the nature of the surface rendered it imperative to do so, but wherever a given summit was to be encountered, and it proved to be within the scope of the specified gradients and other conditions, the line was designed in accordance with them, without apparently any, or at most, very little regard being paid to the question of expense, or a consideration of those unforseen contingencies, which works of magnitude, such as those shown upon his section, must inevitably entail, and which have universally occurred within the experience of every engineer."

"I have stated that it was difficult to conceive restrictions more calculated to fetter an engineer in such a gigantic task, but it is still more difficult to devise a cause for the French government having originated such regulations; they could not have derived them from any railways in their own country, for both the lines from Paris to Versailles are direct contraventions of them; they could not have deduced them from the Belgian practice, neither could they have formed a basis in the engineering experience in England, for here they would have learnt, that each case was treated as the local circumstances dictated.

"It is true that engineers may and do differ respecting the precise mode of meeting the natural difficulties which may present themselves in the projection of a railway through a long extent of country, and that they differently estimate the comparative advantages and disadvantages of what are termed good and bad gradients; and though I appreciate more highly than the generality of the profession the ultimate benefits which I believe will always be found to spring from the use of favorable gradients, yet I cannot but feel, and that very strongly, that the application of precisely the same principles as those which governed me in designing the London and Birmingham railway to the section of country now under my consideration between Paris, Belgium and the Northern coast, must lead to consequences which the government and every interested individual would hereafter have reason to lament; and I should not be fulfilling my duty as a member of a

scientific profession were I not at once to avow my conviction of the injurious influence of circumscribing the free exercise and application of professional experience within the contracted limits of a code of specified instructions, which, while they fetter design, must entail expense and inconvenience in the execution."

The exorbitant cost to the government for the construction of the lines located upon these principles, is likewise adduced as a reason for their abandonment. Mr. S. however, remarks, that there appears every disposition on the part of the government to entertain a proposal somewhat modified, to meet his views of the case.

Public convenience and accommodation, have influenced the government in ordering an independant station at the point of departure from Paris—as a negotiation with the Messrs. Rothschild failed in consequence of these gentlemen, influenced by their large interest in the Versailles railway, having made it a *sine qua non* that there should be a common station. The same praiseworthy regard for public accommodation, has in several cases, ordered the carrying of the road, even at an increase of length, through some of the more prominent towns and manufacturing districts, and this the report deems favorable rather than otherwise to the interests of the contracting parties as insuring a larger traffic.

The line proposed, after leaving Paris reaches the valley of the Oise at Pontoise and follows it for a distance of 23 miles to Criel where the valley of La Breche, a tributary must be taken. At this point the absurdity of the restrictions above mentioned is shown. Instead of adopting the favorable low ground, the line would be compelled to ascend gradually, occupying the rough sides of the valley and encountering continual difficulties. The report advises an adherence to the low ground and at the summit a grade of about 1 in 150.

At St. Just, the sudden rise in the cliff involves heavy work, upon any plan. The line then descends to near Amiens, and as this town is ordered to be one of the points, a short branch to it is proposed—a population of 60,000 will amply repay this additional expenditure. Between Amiens and Arras on the Scarpe a difficult and elevated country is encountered for 40 miles. Here again the restrictions imposed would have produced a costly and inconvenient location. At Douai a branch to Valenciennes meets one of the Belgian lines, and further on another branch makes another union at Lille. This part of the line and its branches embraces a valuable traffic through a wealthy coal region.

The main line passes over favorable ground nearly along one of the old canals to Calais, a branch is also proposed to Dunkirk.

Mr. Stephenson prefers the line to Calais instead of one to Boulogne, although the passage from Dover to Paris would be about two hours shorter by the latter—but the connection with the Belgian roads and the traffic already existing are more powerful considerations than this saving of time. It is evident that the travel to the Rhine and generally to the whole of the

northern part of the continent would pass over this line, while the whole of the Paris and southern travel will in addition to a vast local business furnish a very handsome return for the investment.

The cost is estimated for the whole distance 255½ English miles.

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|---|---|
| Excavation, bridging, etc., | £2,390,598 |
| Land and stations, | 1,062,488 |
| Permanent road, | 2,124,976 |
| Carrying establishment, | 531,244 |
| Total, | £6,109,306 |

According to the proposal, £3,076,668 of this is to be paid by the company, the remainder by the government.

The investigation of the cost of construction embraces several very useful tables, which at some other time we may again refer to. The consideration of the existing traffic shows an amount of labor very unusual in such documents and although somewhat of local interest is yet valuable as demonstrating the vast importance of railroads leading to great cities and the profitableness of the investment. As one instance of the importance, even of trifles on such a line, we find that the income at present derived from the transportation of *fish* along the proposed route, *is* over half a million of francs, annually, and for sheep and cattle still more.

We are pleased to find that the views of Mr. Stephenson are so strikingly in favor of the greatest amount of accommodation as conducing to the profit of the capitalist—while the low fare ordered by government, he in some cases proposes to reduce still more.

New York is not so large as Paris, but it *is* a large city and the country around *does* pour in a vast and profitable traffic—but we have yet no New York and Albany railroad to facilitate this traffic or reap the profit.

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The following sensible and timely communication will please most of our professional readers by its pungent and yet civil criticism upon a common and shameful disrespect to engineers. We have frequently spoken of the folly of entrusting the management of a completed road to other than professional men; we have also referred to the assumption of engineering duties by directors—together with the bad effects of this amateur engineering. Our correspondent has, however, opened upon another and no less absurd practice and we hope that together with the promised communication upon the Portland road, he will furnish us with more notices to the same purpose.

The conduct of engineers in not asserting their own respectability, in a great measure is the cause of this and similar evils, and any attempts at a reformation are to be considered as promising, if they emanate from engineers themselves.

**For the American Railroad Journal, and Mechanics' Magazine.**

MESSRS. EDITORS:—As one of the objects of your valuable Journal, is to promote the interests of engineers, a class of professional gentlemen, whose services have been considered important in connection with the construction

of public works, will you allow a few remarks, and extracts, showing how readily directors assume to themselves all of the results of engineering.

The report of the directors of the *Portland, Saco and Portsmouth railroad*, submitted at the annual meeting of stockholders in June last, happens to be the most convenient case for reference; and firstly, to show in what manner the character of that road is regarded by the directors, observe the language of the following extract:

"The obstacles that have arisen from the sinking of the embankments in some two or three places, to a depth seldom, if ever, before known, and the method taken to obviate, or surmount them, were then, (*in a previous report*) adverted to, with a hope expressed, that the latter might prove successful. That hope has been fully realized. The heavy freshets occurring at the moment when the frost was breaking up, having fully tested them."

And, after showing the nett income for six months, they say—

"This is the produce of five months winter, and one of cold weather. The stockholders may surely look forward to better things. The character of the road, shown in the solidity of the embankments, the strength of the masonry, the design and workmanship of the bridges, the form and weight of the rails and the mode of supporting and connecting them, the length of straight lines, the radii of the curves and the ease of the grades, together with the superiority of the passenger cars, and the efficiency of the locomotives, employed, ought to give satisfaction to the travelling public, whose security and accommodation have been the first objects aimed at in its construction and the manner of conducting it."

These prove that the directors are far from dissatisfied with the road and that they view it as a permanent work, and if it were not for one or two mere allusions to an "engineer department," and to "engineers," in the report, very elaborate and satisfactory as it is on other points, one might suppose that the road came into being by some magical power emanating from the directors. After refering to "various surveys," and to the report of June, '41, they add, "The plan then adopted for the engineering department and the system of accounts then devised * * * have all proved effective and satisfactory;" and again, adverting to certain bills rendered by the contractors they say these "cannot be adjusted until the returns of the engineers have been examined and approved."

And lastly, an important piece of information is given, to wit

"The engineer department has been nearly or quite settled up—some small additions may be required for services in settling the accounts with the contractors."

Perhaps some one can state who these "engineers" were to whom these passages refer, and the writer leaves that question to be answered from other sources—but a few facts, known to him, may serve to show, if not inconsistent with what has preceded, that there are various circumstances connected with the road which reflect a little credit on these "engineers."

The cost of this road when prepared for the probable amount of business, including about $64,000, paid stockholders for interest on assessments, will not exceed, "much if any, the original estimate, of about $23,000 per mile."

The expenditures, to Jan. 1st, '43, were, including interest, $1,107,240·16. The length of the road from the centre of the Piscataqua river, at Portsmouth, N. H., to the depot in Portland, is 50 miles 3093 feet. The surveys were begun January 1st, 1841. The contracts were made for the entire distance on the 1st April following. The topographical examinations and the location, were consequently made within the three worst months of the year. One line was located, passing through York, east of Mount Agamenticus, Wells, Kennebunk, Saco, to Portland, and another, which was subsequently adopted, diverging westerly from the first, at the Piscataqua, and passing through Eliot, South and North Berwick, west of Agamenticus, joining the first named, about 35 miles from Portsmouth. Thus making some 86 miles of actual location, to accomplish which, in a part of the country requiring the most careful surveys, even at the most favorable season for examinations, much time and labor were of course expended on primary lines, exceeding by far, in this as in most cases, the length of the line of location.

In ten months from the letting of the work, 13 miles, and in twenty months, the 50¾ miles have opened for travel—crossing the deep and rapid Piscataqua, by repairing and improving the old bridge, and connecting, at Portsmouth, with the *Eastern railroad*, thus making a continuous line of road from Boston to Portland, about 104 miles, and on the 14th January, 1843, the engineer department was dissolved by the resignation of the gentlemen of whom it was composed.

There are other points connected with this road which might interest your readers, and in the hope that some one will yet go somewhat into the details, the writer has the more readily passed them by—his object is rather to protest against the unmanly course so prevalent among directors of public works, of hiding as far as possible, any allusions which may let stockholders know to how great an extent they are indebted to engineers, not only for the successful construction of the works in question, but for the very materials of the reports themselves.

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ACCIDENTS UPON RAILROADS.

Our last number contained a notice of several recent railroad accidents together with some pretty severe remarks upon the culpability of those who allowed such accidents to occur. One of the editors having received the impression that one of these catastrophies had not been the result of gross carelessness on the part of the company and that many of the articles in the public prints had been written in ignorance of the facts and in a very improper spirit. With this view of the case, a notice was prepared, but during an absence from the city, facts came to the knowledge of the other editor in regard to this and to other accidents, which gave occasion for the article which finally appeared. Since then we have understood that in one of the cases alluded to, erroneous statements were promulgated. We refer to the collision on the Reading railroad, which, it appears, was the result of direct

disobedience of express order, and not to any fault of the company or its superintendant, Mr. G. A. Nicolls. It is but an act of justice to Mr. N. that this correction should be made, for we should feel great regret that any notice in this Journal, directly or indirectly could be construed into an unjust criticism upon the conduct of so worthy and efficient an officer.

No harm has been done, however, by the discussion, which has been the means of eliciting the truth and of opening the eyes of companies and their agents to the necessity of an official organ through which to communicate to the public a correct statement of facts. If we are compelled to draw our information from the newspapers, we of course, must be influenced by the facts as we find them given—but if upon such occasions we receive our account directly from the company—by means of our various exchanges, correct statements can be afforded to the public and with an authority which cannot be given as things are now arranged.

Among the various notices which have appeared, our attention has been drawn to a series of communications in the Baltimore American over the signature T. These seem to us to convey very just views and to embody much information. Extracts from them will be found on another page.

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The following extract of a letter from a London correspondent to a friend in this city, will prove interesting.

*London, May 19th,* 1843.

My Dear Sir:—Thinking you may feel an interest in the report made by the celebrated engineer, Robert Stephenson, on the projected railway from Paris to Lille and Vincennes with a branch to Calais, (the whole distance about 256 miles) I send it to you by the present conveyance. It contains much interesting matter, and I hope will prove of interest to you. I should be glad to hear from you respecting the prospect of your getting on with your magnificent scheme from New York to Albany. It appears to me, this is a work of such paramount importance to the city of New York, since the completion of the whole line of railway from Buffalo to Boston, that sufficient enterprize will be excited to complete it. Let me hear as soon as you can conveniently. I have read many of your statements in the American Railroad Journal, as well as in separate pamphlets, and I am thoroughly convinced that this work if properly made, must be of extraordinary advantage to the community, and of great pecuniary advantage to the proprietors of the stock. A rival work on the shore of the Hudson ought to be deprecated by any well-wisher of the prosperity of New York. Both works cannot be supported, and bringing forward this new scheme will probably prevent either from being made. What is doing with this new project—is it given up, or do you feel any danger from it?

I observe by the newspapers that the legislature of your State has granted new facilities to the New York and Erie railroad company, which will probably enable them to finish this gigantic work. Ought not your concern and this great concern and all others in the United States interested in ma-

king railroads, to unite in trying to get congress to abolish the extravagant duty of $25 per ton, on railway iron? This duty is more than the first cost of flat bar railway iron, and not more than $3½ excess over the first cost of edge rails free on board at Cardriff or Newport! A duty of 100 per cent *ad-valorem* on an article of such importance in promoting the prosperity of our common country, and which cannot be made in America, does not show a very enlightened and patriotic policy in our government. I doubt not if the proper efforts be made that congress at its next session will abolish this unreasonable and impolitic tax.

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ACCIDENTS ON RAILROADS.

*Messrs. Editors*—The frequent accidents on railroads, arising from collisions with cattle upon the track, is imminently perilous to human life, and ought promptly to attract the gravest attention of those in authority. There is, perhaps, no branch of our State police which better demands legislative interference, or which, in all previous attempts to deal with it, has been more misapprehended. In all countries the care and improvement of *highways* are important objects of public concern, and in their management in every well regulated community the convenience and safety of those having occasion to use them are deemed of paramount necessity. It is obvious that railroads have worked essential changes in our system of highways, and that little has yet been done to adapt the laws to the new order of things. * * It is apparent that those immediately engaged in railroad opperations have a deeper interest in their regularity and safety than any one else; for not only are the consequences, in case of accident, vastly more serious to them than to other common carriers; but, besides the risk incurred by the immediate agents, in common with the lives and property committed to their care, the most ordinary accident, arising from any cause whatever, can seldom happen without involving a loss to the company much greater than any amount of their daily profit. Although this should not dispense with the strictest regulations to ensure proper care and precaution from the parties concerned, it may well dispose the legislature to contemplate other sources of danger which due care upon the part of the companies or other agents cannot possibly guard against; and we think the unlimited trespassing of cattle upon the track of a railroad presents a principal source of hazard, for which an adequate provision has not yet been made.

We presume that, according to the universal principles of law, if any one suffer damage from the want of proper care by the agents employed, the companies would be liable. In this State, too, special legislative enactments have been made not only in aid of the charters and of the rule applicable to other carriers, but creating new responsibilities and imposing additional penalties unknown to the common law. It may be hoped, therefore, that as far as the companies are concerned these are sufficient to attain all that the laws can reasonably enforce.

It is understood also that the managers of most, if not all the railroad companies, have co-operated with the law makers in these commendable efforts; that they employ the fullest complement of agents of known sobriety and competent skill, and at the highest rate of wages; and exact the performance of their duties by the strictest contracts and severest penalties. It is believed also that they have at considerable expense established a supervisory force along the line of their roads to keep off cattle and look after other obstructions; and, as far as the curvatures of the road will admit of it, have

placed upon the machinery the best contrivances which have yet been discovered, for the purpose, in case of accident, of protecting as far as possible the passengers and property.

The legislature has shown too that in their opinion something is due from the public to the safety of the lives and property passing over these new description of highways. They have accordingly prohibited all persons from riding on horseback, or riding or driving or leading any horse or horses, mule, oxen, carriage, wagon or other vehicle, or any cattle, sheep, hogs or stock, upon or along any railroad; and "to protect the lives of persons travelling on railroads within this State," they have made it felony in any person to place or cause to be placed on any railroad anything calculated to obstruct, overthrow or divert from the track any car passing on the road with the view or intent to obstruct or overthrow any car, and they have declared that if death ensue from any such obstruction, the person placing or causing it to be placed upon the road shall be guilty of murder. All these provisions, however, relate to intentional offences, or to crimes of such deep atrocity as, it may be hoped, will seldom be committed; leaving wholly unguarded those sources of danger, which though they may proceed from no criminality are of daily occurrence, and not less perilous. To what end, it may be asked, are railroad companies made, as unquestionably they should be, strictly responsible in case there should be any want of care in avoiding obstructions found upon the road, if no means be taken against placing such obstructions upon it, *intentionally* or *otherwise?* The *safety* of the *passenger* requires that *he* should be protected not only against the negligence of the railroad agent in running over an animal on the track, but also against that of the owner who carelessly permitted the animal to be there—and this protection the law should afford him.

The question is not between the railroad companies and the public; nor whether this or that degree of care upon the part of agents of these companies is sufficient; for all that is possible for these to bestow should be and is already exacted with the utmost severity. The real question is, in what manner the safety of the lives and property of the citizens passing over railroads can be best promoted, and by what means those causes most likely to produce mischief may be prevented. * * * *

It is notorious that most accidents upon railroads are produced by collisions and cattle trespassing upon the track; and, from the fact that these casualties are happening upon all roads, in all parts of the Union, and under every system of management, it must be evident that in the nature of the case where the obstruction is found, the collision is inevitable. Who, indeed, can suppose that an engine driver, or other agent, would risk not only his place, but his life, or limb (the latter in his condition important almost as his life) by needlessly running his engine into an animal found on the track?

The rate of speed usually maintained on railroads, and which without such obstructions as we are treating of, may be maintained with greater safety than can be relied upon in the ordinary conveyances (as is satisfactorily shown by the minutest inquiry by a commission instituted by the house of commons in England,) is one of the chief purposes of these improvements, and any attempt to limit the speed at a rate at which an engine and train might be suddenly checked would be destructive of these enterprizes, and consequently impracticable. Those acquainted with the operations of a railroad know that at a speed of not more than ten or fifteen miles per hour the progress of an engine attached to a heavy train of cars cannot be arrested even within the space of one hundred yards, and that attempts to do

so often produce a concussion, in itself extremely hazardous. Upon a straight line of road, ordinary obstructions may and ought to be discerned at a sufficient distance to admit of the requisite precaution, and we are not aware of any case of collision that has happened under such circumstances. But in passing curvatures, common to all roads, (often connected with steep grades, requiring such a quantity of steam, both in ascending and descending, as to render it absolutely impossible suddenly to control its power) the obstruction meets the eye of the engine driver too late to enable him by any means whatever to avoid it. It is also well known to every one at all acquainted with the subject that *cows*, especially, seldom or never show any alarm on the approach of the engine; they often get upon the road when least expected almost in contact with the train, and sometimes suddenly emerging from their concealment in the bushes on the side, pass upon the track within a few feet of the locomotive. It must be evident that in all such cases a collision is entirely inevitable; and it may be safely averred that in at least ninety-nine cases out of one hundred accidents from these animals have happened in this manner.

If any question be made upon a point of so much importance to the community at large, the legislature, by instituting an inquiry by means of a commission, as is constantly done for the same purpose by the English parliament, may readily resolve all doubt. The result, I am convinced, will make the case even stronger than I have stated it; and show conclusively that in almost every instance where cattle are run over on a railroad no human precaution could have prevented the collision.

An attempt to fence off a line of railroad from the depredation of cattle is out of the question. Even if it were reasonable to impose such upon the companies, which it manifestly is not, the numerous county roads by which the railways are intersected and crossed would render the attempt wholly impracticable. In this connection it may also be observed that all railroad companies have not only paid the full value of the ground occupied by their works, but in most instances the expense of fencing the contiguous land has been actually included in the damages allowed to the owners.

Now, if it be not in the power of railroad companies, by any degree of care consistent with the business and convenience of the public, to give greater safety to passengers and property, and there yet remain a source of imminent peril to both, should not a remedy be looked for elsewhere? Have not the public the right to demand it? Under such circumstances, we deem it the plain duty of those in authority to look to the origin of the danger, and to apply the remedy to *it*. It arises manifestly from the indifference or carelessness of the owners of cattle in the vicinity of railroads, who, instead of keeping their stock within proper enclosures, turn them out in the morning with a clear knowledge of the fatal mischief they may occasion at any hour of the day; or, what is even less excusable, turn out their herds at night, not only with the same knowledge of the danger they occasion to others but with a much stronger probability that before the dawn of day they may prove the immediate and unavoidable cause of the most fearful destruction of human life! What state of circumstances can justify a longer toleration of such use of a man's property? Should it not require a case of extreme poverty, or other urgent necessity to warrant any man to claim the privilege of supporting his cattle on the public or turning them out to do what mischief they may, at the hazard of such consequences? The just, humane and most effectual remedy, then, would be to prohibit the owners of cattle from allowing them to range at large in the vicinity of railroads, and to require that all cattle in such situations be kept within proper enclo

sures. It is in the full persuasion that no other remedy will prove effectual that I have ventured to trouble you with this paper, I am by no means insensible of the apparent hardships with which such a general regulation may be supposed to bear upon a few indigent persons; though I am not willing to concede that salutary laws of general necessity should be dispensed with because they may give rise to cases of individual hardship. It is not from such cases, however, that the great mischief of which I am treating is to be apprehended. If only the cattle of a few poor persons were allowed to range unrestrained in the vicinity of a long line of railroad the danger would be by no means so imminent, nor the necessity of the particular remedy so urgent. The chief source of mischief arises from the too prevalent and negligent practices of a very different class of our population; who, with ample means to provide for their stock, leave their fields unenclosed, or turn out their cattle upon the commons and in the highways, as reckless of the consequences as if the danger from trespassing upon railroads did not exist. It is by these means that herds of cattle are every where wandering by the line of railways, obstructing the track, and daily occasioning collisions frightful to all, and, in many instances, fatal to many whose business obliges them to use that mode of conveyance.

Now although these practices might have been deemed harmless, and therefore tolerated, in a different state of things, we think it only reasonable that having proved to be of most mischievous tendency under our present system of public improvements, they should now be prohibited and discontinued.

But, Messrs. Editors, I have already extended this article to an inconvenient length, and will close it. My present purpose is accomplished, in calling public attention to an evil of serious magnitude, and indicating what I consider the appropriate remedy. At another time, I may follow up the subject with some further observations calculated to embrace the views here taken.—*Balt. American.* "T."

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*Railroads in Austria.*—An article from a Vienna paper of May 28th, states that the number of workmen employed on the railroads of Austria, was at that time more than 40,000, and that in a short time the number would be increased to 60,000. The railroad from Vienna to Prague will be finished in 1845.

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☞ We are indebted to Mr. John A. Roebling for a valuable communication on the subject of Wire Rope, and to Mr. J. I. Shipman for an interesting report of a Railroad Trial. Both of these communications will appear in the next number.

☞ Several returns to our application for Railroad Tariffs will appear also, in our next.

☞ Arrangements have been made for completing a double track on the Pottsville and Philadelphia railroad. Receipts last month $51,000,—Good.

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AMERICAN

# RAILROAD JOURNAL,

AND

# MECHANICS' MAGAZINE.

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For the American Railroad Journal and Mechanics' Magazine.

## AMERICAN MANUFACTURE OF WIRE ROPES FOR INCLINED PLANES, STANDING RIGGING, MINES, TILLERS, ETC. BY JOHN A. ROEBLING, CIVIL ENGINEER.

The art of manufacturing ropes of *wire* is comparatively new. Numerous attempts have been made in Europe and here, and most of them have proved failures. A collection of parallel wires, bound together by wrappings in the manner of a suspension cable, is no rope and not fit for running, it can only be used for a stationary purpose. The first rigging made in England, was of this description. The difficulty in the formation of wire rope arises from the unyielding nature of the material; iron fibres cannot be twisted like hemp, cotton or wollen; their texture would be injured by the attempt. To remove this obstacle, some manufacturers have resorted to *annealing*, and thereby destroyed the most valuable properties of iron wire, viz. its great strength and elasticity.

My first attempts in the manufacture of wire rope, were made four years ago, my intimacy with the construction of wire cable bridges induced me to investigate this matter. The principles of my process differ from those of the English manufacturers, they are original and secured by patent. The novelty of my proceeding chiefly consists in the spiral laying of the wires around a common axis *without twisting the fibres*, and secondly in subjecting the individual wires while thus laying to a uniform and forcible tension under all circumstances. By this method, the greatest strength is obtained by the least amount of material, and at the same time a high degree of pliability. Each individual wire occupies exactly the same position

NOTE.—By the term elasticity, I mean the property of wire to stretch and give when subjected to a strain, and to resume its former length after the strain ceases, without suffering a permanent elongation. The extent of elongation of iron is in proportion to the tension. In estimating the strength of a rope, the strain it has to support, should never exceed the limit of elasticity. A permanent strain requires some more allowance.

The elongation of good wire of No. 14, 15 or 16, amounts, according to my own experiments to $\frac{1}{1000}$ of its length per ton per square inch. A strain of 15 tons upon a rope of 1 square inch section and 1000 feet long will produce an elongation of 3 feet. The limit of elasticity for working rope I have assumed at 15 to 20 tons per square inch, according to the size and quality of the wire. A greater strain will produce permanent elongation, and if repeated, at last a rupture.

throughout the length of a strand; another result of the precision and force applied in laying, is the close contact of the wires, which renders the admission of air and moisture impossible.

Three years ago I offered to the board of canal commissioners which was then in power in Pennsylvania, to put a wire rope of my manufacture on one of the planes of the Allegheny Portage railroad, at my own risk and expense, the value of the rope to be paid in proportion, as it rendered services equivalent to a hemp rope. This liberal offer however was rejected and not considered until the present board came into office. Last year I put three ropes, measuring in the aggregate 3400 feet, 4½ inches circumference, in operation on plane No. 3. Owing to the want of adhesion, I had at the start to contend with some difficulties. By means of a double groove on the receiving sheave and a guide sheave placed back of it, which crosses the rope and leads it from one groove to the other, which improvements were added to the machinery last winter; I succeeded in doubling the adhesion. When in unfavorable weather there is delay and slipping on the other planes the wire rope can at all times pull as heavy a load *without* a balance, as the engine is capable of hauling. The planes of the Portage railroad require hemp ropes of 8½ inches circumference, made of the best Russia or Italian hemp, and which cannot be trusted longer with safety than one season. They are frequently from reasons of economy continued 1¼ seasons; much however, depends upon the weather and business. The unfavorable circumstances under which the wire rope had to work last year, effected it some; the wear of the whole of this season, however, is not perceptible, and its present condition promises a long duration. I am now manufacturing another wire rope of 5100 feet long in four pieces for plane No. 10.

The first rope of my make, 600 feet long, 3¼ inches circumference has now been in successful operation two seasons, hauling section boats from the basin to the railroad at Johnstown. Two more were put to work last spring at the new slips at Hallidaysburg and Columbia. From my present experience, I may safely assert that *wire rope* deserves the preference over *hemp rope* in all situations much exposed, and where great strength and durability is required.

By my process of manufacture, the same pliability is imparted to the rope which is proper to the wire itself. Paradox as this may appear, it is nevertheless a fact and is easily explained. By pliability is here understood the extent of flexure to which the rope or wire may be subjected, without producing a permanent bend; when released the rope must resume its former and straight position. To bend a rope requires force, and this force is in proportion to its areal section, *caeteris paribus*.

Well manufactured *iron rope* is *more* pliable than *hemp rope* of the same strength. I am manufacturing tillers of fine wire, capable of bearing 3000 lbs. and which ply around cylinders as small as four inches in diameter, and in which the wires are so compactly laid, that not the slightest shifting in their spiral position is to be observed. A number of my tillers are in use

on the Ohio and Mississippi. Such rope would be pliable enough for running rigging and be of long duration.

I will here add a few remarks on the introduction of *standing wire rigging* in place of *hemp rigging*. This subject has for some years passed, engaged the attention of the navy department of England and France, and the success which has attended the use of wire in place of hemp for shrouds and stays in the naval and commercial service of Great Britain, would, it appears, seem to warrant an attempt to test its utility on our national vessels.

Allow me to cite here a few remarks from the notes of Capt. Basil Hall, on a tour through Switzerland, and while examining the wire suspension bridge at Fryburg. He says, "attempts are now making and will ere long succeed, to introduce wire rigging, which is stronger and better than *chain*, because less dependent on the accidental quality and careless manufacture of a single part. How strange it is, that the plan of making *wire bridges*, so successfully adopted in France, and elsewhere, should not have found favor enough in England to be fairly tried on a large scale. Fryburg-bridge 301 feet *wider* than Menai, at least equally strong, has cost only one-fifth of the money. I do not think wire will answer for running rope; but for standing rigging it may, I conceive, be most usefully substituted for hemp, for with equal strength experience shows it to be lighter."

The cables of suspension bridges are stationary and will, when protected against oxidation, last an indefinite period. Standing rigging, (when compared to running rope) is nearly stationary, and there is little wear but what arises from the direct strain, which *if* supported by sufficient strength, will have no deteriorating effect. In comparing the two materials, wire and hemp for rigging, the state of preservation and time of use should be considered. For instance, a hemp stay of a certain size, made of the best Italian hemp, will when new, possess two-thirds of the strength of a wire stay of the same weight per foot; but let the two stays have been exposed and served five years, then the strength of the hemp stay will be gone, while the wire stay will not show any perceptible reduction. In this case, of course, a common wear and tear is supposed.

The most prominent features of wire rigging as compared to hemp rigging, are its great durability, less weight and size, less surface exposed to wind, less danger in time of action of being destroyed by shot. Another good quality of the wire rope is its great elasticity which is quite sufficient to counteract the effect of a sudden jerk, while a vessel is rolling heavily at sea. The elasticity of hemp rigging is only to be relied on to a very small extent, it will give and stretch a great deal but not return.

A common objection of those not familiar with the nature of wire rope, is its supposed rapid destruction by oxidation, but no apprehension is less founded than this. Running wire rope while in use either in or out of water, in mines or any other situation, will not even require the protection of oil, varnish or tar; while at work it will rust no more than a rail or a chain in use, but when idle, oxidation will affect it in proportion to the surface expo-

sed. As, however, the process of laying is carried on with mathematical precision, by which the wires are brought into the closest contact, the assemblage of wires in form of a strand, present a solid rod, which will be no more subjected to rusting than the link of a chain of the same size. The individual wires as well as the strands and ropes are coated with an excellent varnish during the manufacture. Wire rigging will require no other protection but oiling or tarring once or twice a season. Where elegance is an object, black or green paint may be used. Rigging made of zinked wires and not painted, would present a most elegant appearance and be exempt from all rusting.

Wire rope can be spliced in the same manner as hemp rope. The attachment of wire shrouds to the sides of the vessel and to the masthead and their connection with the rattlines (which should also be of wire) can be effected by the old method; the use of wire however, will suggest some modifications better adapted to the material.

Some wire rigging has been manufactured in England which simply consists of a collection of parallel wires bound together and served over with hemp. These mixtures, as experience has proved in the case of tiller-ropes, are objectionable, the wire will rust inside of the hemp in spite of all protection by varnish; besides the cover of hemp, which adds nothing to the strength, is only an additional expense.

Iron is now gradually superseding wood in the construction of vessels, a complete revolution in ship building has already commenced in England. Although very expensive at first, iron ships will prove the cheapest in the end. Are there any well founded objections to wire rigging, which assumes the same relation to hemp rigging as wooden ships to iron ones? There are none. Why then not test this matter by encouraging those who are capable of bringing it to perfection? A number of iron vessels are now building for the naval and revenue service, which seem to offer appropriate occasions for the test of this matter.

*Saxonburg, Pa., Sept.* 1843.

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ACCIDENTS UPON RAILROADS.

*Messrs. Editors;*—In a previous paper I adverted to the essential change worked in the system of highway police by the introduction of railroads, and the application of steam power to vehicles on land; and pointed out the necessity of correspondent regulations for the safety and protection of such as have occasion to use these new improvements. I think the subject cannot be too earnestly pressed upon the attention of those who have the power and whose duty it consequently is to deal with it.

It is foreign from my present purpose to advert to the ultimate effect which the new and wonderful power now in successful operation is destined to produce upon all the relations of trade and of society at large; but it may well be supposed that the suddenness with which the invention came upon the public, and the extraordinary results that immediately attended it, prevented the proper attention to the means more particularly calculated to insure safety in its practical operation.

In the prosecution of these improvements the United States and England

took the lead; and though in both countries the common high road was rapidly superseded by an agent of such vast power for good or ill, some time elapsed before the authorities of either appeared aware of the necessity of appropriate regulations adapted to this new species of communication. This branch of the subject first attracted the attention of the government in England.

In the year 1838 the reports of "commissioners appointed to consider and recommend a general system of railways for Ireland," was presented by the command of the Queen, to both houses of parliament; and in these the dangers of railroad travelling, as compared with that on the common highway, and also the means which had already been provided against the former, are particularly considered.

The reports were subjected to the fullest discussion by some of the ablest writers in England, and I cannot do better than devote the most of this article to a quotation from one of the best papers to which the investigation gave rise. The reader will be thereby better enabled to appreciate the observations I have already submitted, and those which I may hereafter make.

It will be perceived from the facts stated in the quotation, that the rigorous exclusion of cattle from the track is part of the means resorted to in England to guard against the dangers upon railroads, and that to this precaution the extraordinary safety which has attended them may be mainly attributed.

The writer is treating of those parts of the reports relating to the dangers attendant upon the old and new description of roads, and, after many pertinent observations upon the advantages of the extraordinary velocity with which passengers and heavy goods are transported upon railroads, he proceeds as follows:

"The dangers of travelling in either fashion may be divided into four heads, namely:

1. The dangers of the road.
2. The dangers of the carriage.
3. The dangers of the locomotive power.
4. The dangers arising from momentum, or from the weight of burden, multiplied by the velocity at which it is conveyed.

"As regards the first of these, we are certainly humbly of opinion that *cæteris paribus*, a railway must be less dangerous than a high road; because it is flat instead of hilly; because a surface of iron is smoother than a surface even of broken stones; because the lip of the rail which confines the wheels is an extra security which the common road does not possess; and because wagons, vans, carts, private carriages, and all other vehicles, *as well as horses and cattle, belonging to the public, are rigorously excluded.*

"As regards the second of these dangers, we submit to our readers that *cæteris paribus*, a railway car must be less dangerous than a stage or mail coach, because its centre of gravity, when empty, is low instead of high; because its passengers sit low instead of high, inside and not outside—because its axles, receiving no jerks, are less liable to break—and consequently because altogether it is less liable to overset.

"As regards the third of these dangers, we conceive there can be no doubt whatever, that, *cæteris paribus*, a locomotive engine must be less dangerous than four horses, because it is not liable to run away, tumble down, or shy at strange objects or noises—because it has no vice in it—because it is not, like a horse, retained and guided by numberless straps and buckles, the breaking of any one of which would make it take fright. And lastly, because, by the opening of a valve, its restless enterprizing spirit can, at any

moment, be turned adrift, leaving nothing behind it but a dull, harmless, empty copper vessel.

"It is true that it is possible for the boiler to explode, yet as the safety-valve is the line of least resistance, that accident with mathematical certainty can be so easily provided against, that it is not now apprehended; and even if, contrary to philosophical calculations, it should happen, the sudden annihilation of the locomotive power would injure scarcely any but those firemen or engine drivers answerable to the public for their neglect which had occasioned the misfortune, while to the great bulk of the passengers, it would create no inconvenience except a gradual halt of the train.

"With respect to the fourth of these dangers, it must be admitted, that both the speed and weight of a railway train are infinitely greater than the momentum of a mail or stage coach; yet, if the latter, in case of serious accidents, be sufficient to cause the death of the passengers, it might be suggested that the former can do no more; just as it is practically argued by old soldiers, when they rebuke recruits for dreading artillery, that a musket ball kills a man as dead as a cannon shot. If a railway train, at full speed were to run against the solid brick work of the tunnel, or to go over one of the steep embankments, the effect would mechanically be infinitely greater, but perhaps not more fatal to the passengers, than if the mail at its common pace, were to do the same; besides which, it must always be remembered, that though the stage may profess to travel at the safe lukewarm pace of eight miles an hour, yet any accident suddenly accelerates or boils up its speed to that of the railroad, under which circumstance the carriage is ungovernable. In going down a hill, if a link of the pole-chain break—if the reins snap—or if the tongue of a little buckle bends, the scared cattle run away—and it is this catastrophe, it is the latent passion, and not the ordinary appearance of the horses, which should be fairly considered, when a comparison is made between railroad and common road travelling; for surely there is infinitely less danger in riding a horse that obeys the bridle at twenty miles an hour, than there is sitting demurely trotting, at the rate of eight miles an hour, on a runaway brute that is only waiting for the shade of the shadow of an excuse to place his rider in a predicament almost as unenviable as Mazeppa's.

"There is nothing, we understand, at all either dangerous or disagreeable in going what is vulgarly termed "fast," if no object intervenes mechanically to oppose the progress. Now we have already shown that the obstructions which exist on a railroad are infinitely less than those which exist on a high road, inasmuch as from the former *every human being, animal and vehicle is excluded, excepting those safely included in the train.*

"So much for theory; in practice the precise amount of the danger of railroad travelling, even at the commencement of the experiment, will at once appear, from the following official reports, to have been about *ten passengers* killed out of more than *forty-four millions!* [See opposite page.]

Now, in England the average speed upon railroads is at least thirty miles per hour, and from the foregoing observations we think every one will be struck with the miraculous safety with which, with such an extraordinary degree of velocity, railroads have transported so many millions of human beings! When the reader reflects that this safety is chiefly attributable to those rigorous measures by which cattle—the most common cause of obstruction—are excluded from the English roads, he will be apt to inquire whether similar preventives be not equally called for, and should not be adopted in this country.—*Balt. American.* T.

| Names of railways. | Date. From | To | Number of miles. | Number of passengers. | Number of accidents. |
|---|---|---|---|---|---|
| London and Birmingham, | July 20, 1837, | Nov. 5, 1838, | 19,119,465 | 541,360 | 3 cases of contusion, no death, (1.) |
| Grand Junction, | July 4, 1837, | June 10, 1838, | | 214,064 | 2 cases of slight do. do. (2.) |
| Bolton and Leigh and Kenyon and Leigh, | June 13, 1831, | October 1, 1838, | 3,923,012 | 508,763 | 2 deaths, 3 slight contusions, (3.) |
| Newcastle and Carlisle, | March 9, 1835, | October 1, 1838, | | 8,540,759 | 5 deaths, 4 fractures, (4.) |
| Edinburgh and Dalkeith, | Summer of 1832, | Sept. 30, 1838, | | 1,557,642 | 1 arm broken, (5.) |
| Stockton and Darlington, | October 10, 1832, | October 10, 1838, | 2,213,681 | 357,205 | None. |
| Great Western, | June 4, 1838, | Nov. —, 1838, | 4,109,538 | 230,408 | None. |
| Liverpool and Manchester, | Sept. 10, 1830, | Sept. 28, 1838, | | 3,524,820 | 8 deaths, no fractures, (6.) |
| Dublin and Kingston, | Nov. 14, 1836, | Sept. 1, 1838, | | 26,410,152 | 5 deaths and 3 contusions to passengers. |
| London and Greenwich, | Dec. 14, 1836, | Nov. 5, 1838, | 484,000 | 2,880,417 | 1 passenger slightly bruised. |

1. None of these accidents occurred to actual passengers.
2. None of these accidents occurred to actual passengers.
3. None of the persons killed were passengers.
4. One of the persons killed was a passenger.
6. The whole of these were passengers; one of them, a sergeant in charge of a deserter, who jumped off the carriage while in motion. The serjeant jumped after him to retake him, but was so much injured that he died; 3 others got out and walked on the road, and were killed; the rest suffered by collision of two trains, at different times. These include all the casualties from the very commencement of the working of the line."

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*Railway and Common road Travelling.*—The Paris papers contain advertisements of diligences which leave Paris daily for the southwestern parts of France—Tours, Bordeaux, etc., by the Orleans railway. These diligences proceed upon the railway to Orleans, a distance of about 80 miles, and on their arrival are immediately transferred, without unloading of either passengers or baggage, to wheels and vehicles drawn by horses ready harnessed, and the journey is continued upon the common roads. On the arrival of these vehicles at the railroad from the south they are separated from the wheels, and without any disturbance of the passengers are transferred to the truck provided for it, and attached to the locomotive train, and the journey is thus continued to its termination. To facilitate this operation a machine for transferring the carriage from one set of wheels to

the other has been invented by M. Arnoux, which was first introduced, and as we learn with entire success, on the Orleans railway on the 10th June. The number of passengers on the line of the Orleans railroad in the month of June was 50,329, and the amount received for passengers, post chaises, horses, merchandize, etc., was 320,417 francs. On the same railroad to Corbeil, in addition to those on the Orleans line, the number of passengers in June was 74,420, receipts from all sources 114,505 francs; total of passengers in the month 124,749; receipts 434,922 francs.

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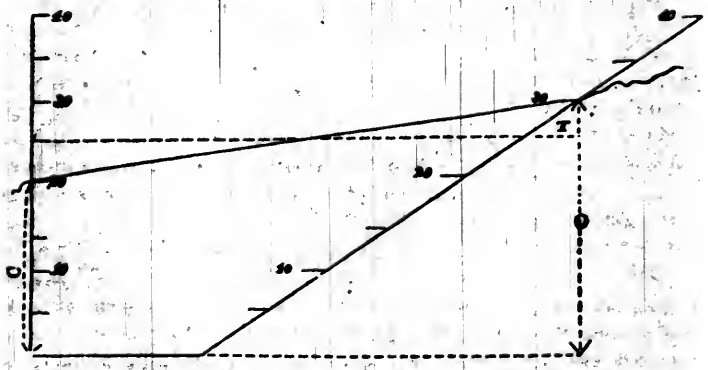
NOTES ON PRACTICAL ENGINEERING.—NO. 2.

*Cubical Quantities.*

In preliminary surveys the object is to determine from the levels of the centre line the quantities of excavation and embankment to such a degree of accuracy, as to give a fair view of the absolute cost and also of the relative merits of the rival lines. Where there is no transverse slope the degree of accuracy is limited only by the number of levels in a given distance and the calculation is as easy and expeditious as can be desired.

When the ground slopes transversely, the inclination is taken by the level and rod or by the slope instrument. In the great majority of cases the latter will be the more convenient method. Having the centre levels and the slope on each side, we are prepared to calculate the cubic content, on the assumption that the surface of the ground is even from the centre to the point where the cutting or embankment runs out. It is not intended here to examine the merits of various modes of finding these quantities, whether by tables or by a graphical process, but to suggest a combination of the two which appears to offer some advantages in hill-side work.



Draw a half section of cutting, as in the wood cut, to a scale of about half an inch to the foot, on which the divisions at centre and on the slope may be distinctly marked to tenths of a foot; though two tenths would be near enough in practice. If the inclination be taken in degrees, then with a protractor and with a thread at the given angle over the centre cutting we have the point where the slope cuts the surface of the ground and of course

the depth O. The half sum of these depths in a table of level cutting will give a quantity too great by a triangular prism T, having its altitude equal to $\frac{1}{2}$(O—C) and for its base $\frac{1}{2}$(O—C)$r$.

*Example.* Depth of cutting at centre 20 feet, half width of base 20 feet, slope 1$\frac{1}{2}$ to 1 and depth at outside stake determined as above, 30 feet; required the cubic content per 100 feet.

| | |
|---|---|
| (20+30) per table of level cutting | = 3,588 cub. yds. per ch. |
| (30—20) per Mr. Johnson's table of prisms | = 69·4 |
| | Content = 3,518·6 cub. yds. per. ch. |

omitting the correction for longitudinal slope as is usual in preliminary surveys. This plan of approximating the cubical contents requires, in addition to the ordinary tables, merely a table of triangular prisms and a half section of cutting and embankment. For the latter it is only requisite to erect a perpendicular at the proper point between the centre of cutting and the slope, when the slopes are equal; if unequal a separate diagram may be used.

In place of taking the transverse inclination of the ground in degrees it may be taken in "feet rise" in a given distance—say the half width of roadway—then the following plan may be adopted.

Mark on the vertical line of centre cutting not only the depths, but also the cubic yards per chain due to those depths and draw horizontal lines from the centre to the slope at each division. Then the centre cutting and rise in half breadth being given, place the edge of a graduated rule on these two points—the zero over the centre cutting. The point where the edge of the rule crosses the slope determines of course, the height O; the half distance between these points will be on the horizontal line on which is marked the cubic content per chain due to a depth = $\frac{1}{2}$ (C+O). The divisions on the edge of the rule will give this half distance at a glance, and, to prevent confusion, the horizontal lines may be drawn in different colors. This quantity will therefore be called off by inspection. The correction may be determined in a similar manner. Graduate the edge of a short rule to the same scale as the line of centre cutting, but mark on the divisions the cubic yards per chain contained in triangular prisms of which these divisions represent the altitudes. Then, placing the zero of this rule at the centre cutting, the division where the horizontal line, determined above, crosses the edge of this rule will give the correction also by inspection.

It frequently happens that the choice lies among a number of lines connecting the same points and not materially differing in the quantity of earthwork. In such cases a close approximation to the actual quantity is necessary, and the calculations become laborious. It is for the reader to decide whether the methods suggested in these notes compare favorably or otherwise with his own practice. If the latter, he will perhaps make his views known through the columns of the Journal.

The following table may be useful in some cases of earth-work and masonry. It gives the correction per cent. to be deducted from the average of the bases of frustrums of pyramids or, which is the same thing, from the

half sum of the solid contents of two triangular prisms erected on these bases. Suppose D and d to represent the end areas of a frustrum of a pyramid whose altitude is 1, then the solid content will be $\frac{1}{3}(D+d+\sqrt{Dd})$; but by averaging the end areas it will be $\frac{1}{2}(D+d)$. Table II gives the deduction per cent. to be made from $\frac{1}{2}(D+d)$ to give the true content.

TABLE II.

$$\left\{\frac{D+d}{2} \quad \frac{D+d+\sqrt{Dd}}{3}\right\} \frac{100}{\frac{1}{2}(D+d)}$$

| d \ D | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1·90 | 4·46 | 6·67 | 8·49 | 10·0 | 11·28 | 12·40 | 13·33 | 14·15 |
| 2 | | ·67 | 1·90 | 3·22 | 4·46 | 5·62 | 6·67 | 7·62 | 8·49 |
| 3 | | | ·34 | 1·06 | 1·90 | 2·78 | 3·64 | 4·46 | 5·23 |
| 4 | | | | ·20 | ·67 | 1·26 | 1·90 | 2·56 | 3·22 |
| 5 | | | | | ·14 | ·46 | ·90 | 1·39 | 1·90 |
| 6 | | | | | | ·10 | ·34 | ·67 | 1·06 |
| 7 | | | | | | | ·07 | ·26 | ·52 |
| 8 | | | | | | | | ·06 | ·20 |
| 9 | | | | | | | | | ·05 |

W. R. C.

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THE LONG ISLAND RAILROAD COMPANY *vs.* LUTHER LOPER.

This was a resort of the L. I. railroad company, to the legal course in case of a disagreement as to the value of property taken for the use of the company. On application to the vice chancellor, three appraisers were named and accepted by the parties, notices were issued and a day appointed by the appraisers to view the premises and hear such evidence as the parties might choose to offer in reference to value, damage, etc. The appraisers met according to appointment, and the parties appeared with their witnesses, J. R. Lott, Esq. being counsel for Loper, and the company being represented by their president and two directors.

The president of the company offered the map and profile of the ground taken, and the appraisers proceeded to view the land as staked out. The counsel for Mr. Loper then claimed that his client was entitled to receive, 1st, the full value of the land, stated to be $75 per acre, and 2d, a sufficient sum of money to build and maintain a fence on each side of the road for the duration of the charter, and a further compensation for the grain and grass destroyed in the construction of the road. To establish his position several witnesses were called, who testified that the whole farm taken together was worth $50 per acre; that the portion taken for the railroad was worth $60 per acre where the ground was cleared, and $10 per acre where covered with wood; one witness considered the railroad a damage to the farm, and another that it was worth about as much as before, and that the fencing was worth seven shillings [87½ cents] per panel of 12 feet. The testimony of other witnesses on the same side to the same facts was also taken, and the counsel here rested his case.

The president then opened the case on the part of the company, by giving a general statement of the business and condition of the road with a view of showing its operation upon the interests of the landholders, which he claimed was in every case beneficial; he submitted to the commission whether it was just that a party benefitted to the amount of some hundreds of dollars should come forward and claim of the party conferring the favor, a large sum because he himself was not quite so much benefitted as his neighbor through whose land the line did not happen to be located; he could not persuade himself that the commission would be willing to adopt the principle that because some of Mr. Loper's neighbors were benefitted $1000 and Mr. Loper but $500 that therefore the company should pay him, Loper, the difference. And finally, on the part of the company the ground was taken, that the spirit as well as the letter of the statute, required the commission to consider whether the whole farm was worth more or less by the occupation of a portion of it by their road, and he contended that in case he could show as he hoped to do, to the satisfaction of the commission that the land was actually more valuable than before, they were bound to adjudge that there was no damage done; that the term compensation used in the charter could not by a fair construction be limited to a payment in money, but embraced all the advantages in any way connected with the road and that any rise in the value of the property was actually a compensation for the damage as if the same amount was actually paid in money, or any facility in transportation of produce or manure or saving in time, were actually a portion of the compensation required by the statute. In support of this position he cites several cases where railroads, turnpikes and common roads had been established on the same ground, and also the universal custom in cities of assessing benefits and advantages as well as allowing for damages when they occurred, and he contended that these were all parallel cases except that the company's charter gave them no privilege as to the assessment of benefits on those whose lands were not immediately occupied by the company, and confined them solely to the question of damage. He considered it a monstrous perversion of law as well as of common sense to allow a man to be entitled to damage, when the property in question was actually increased in value 50 per cent. by the very parties to whom damage was attempted to be charged. Witnesses were then called who reside along the line of road, to show the advantages they derived from the road in their farming operations, but their evidence was objected to as irrelevant, and witnesses were then called to show what had been the value of the land previous to the location of the road. They testified that Loper gave about $30 per acre for the farm with good buildings, that the ordinary price for cleared land was $20 to $25 per acre, and for wooded land $2 to $5, and several witnesses testified that they considered his land worth from $300 to $400 more on account of the facility of sending his produce, wood, etc., to market, and obtaining a return of manure at the company's prices.

In reference to the fencing, it was contended on the part of the company,

that cattle guards at the cross fences were sufficient, and that no fences were needed to make the road safe; a model of the guards used on the road was exhibited and several witnesses examined as to their effect in protecting the landowner, and here the testimony on the part of the company closed.

The counsel for Loper in reply denied the position that the benefits conferred were to be at all considered, and contended that the legislature had in every case where such a course was intended introduced a specific clause to that effect; that the commission were bound to consider the damage only, without reference to any prospective benefit; that the term compensation signified a payment of a specific sum of money and that any other definition was inconsistent with its usual meaning and with the decisions of the courts in similar cases. He contended that the admission of the principle of offset in these cases would be opening a wide door for all kinds of speculative enterprizes, and that the commission were bound to repudiate such a construction of the law, in justice to the community as well as Mr. Loper. That the similarity supposed in this case to that of city corporations did not exist, and that the omission in the charter to specify the assessment of benefits on other than the owners of lands occupied by the company was sufficient to show that such was not their intention in reference to the owner himself for it would result in great injustice if one man was to be taxed for the benefit of his neighbors and that too, without his consent, while they enjoyed the advantages without contributing a farthing; and finally he cited several cases from Wendal's reports, particularly that of the Mohawk and Hudson railroad company *vs.* Bloodgood, to show the law in reference to fencing, declaring that although he supposed the cattle guards might be some security he considered a fence necessary to the perfect security of the landholder.

The commission decided that the land was worth $10·25 per acre, and that Mr. Loper if he chose to erect a fence on one side through his cleared land should have 70 cents per panel of 12 feet for making and maintaining the same.

NOTE.—Since the above case the vice chancellor, in a case reported for and printed in this Journal, decided that no fences were necessary. See Long Island railroad company vs. A. M'Conochie. I have given a sketch of the proceedings because they present what I conceive to be the true ground to be taken in similar cases where amounts are claimed from companies under the name of damages, which should rather be termed a fine for conferring benefits, inasmuch as the amount claimed is generally in exact proportion to the advantages conferred. I believe that the commissioners of public works in most of the United States adopt the principle of offset in estimating damages and I cannot see why the principle should not be followed out in similar cases.

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*Tolls and Trade of the Canals.*—The amount of flour and wheat arrived at the Albany office during the 2d week in October, was flour 57,838 bbls., wheat, 5,674 bush. Making an aggregate of 58,970 barrels. The amount of merchandize cleared from this office during the same time amounted to 2,998,100 lbs.

Tolls during the same week, amounted to $8,953 52. There is a slight falling off in the receipts of tolls and the shipments of merchandize from the first week, but the arrivals of flour exceed those of the first week in October, by 3,946 barrels.—*Albany Argus.*

Being a party referred to in the communication of Mr. Latrobe, propriety forbids that we should say more, at present than that we commend it to the earnest attention of our readers as containing the outlines of a plan which appears to be in some form or other regarded by most of the Profession as the only feasible and acceptable mode of producing a union of the Profession of Civil Engineers.

For the American Railroad Journal and Mechanics' Magazine.

It is known to most of the Profession throughout the United States, that in the year 1839, an attempt was made to establish "an American Society of Civil Engineers." A convention, having this object in view, assembled at Baltimore in February of that year, and the measures then adopted seemed as conducive to the end proposed as could have been devised, and were carried faithfully into effect by the officers entrusted with their execution. The project, however, failed, as had been predicted by those unfriendly or indifferent to it, and feared by its advocates and supporters. The causes of the failure were obviously to be seen—in the wide space over which the members of the institution would have been scattered, rendering their meetings inconvenient and expensive—in the sectional feeling attendant upon the division of the country by the boundaries of distinct States, each having its own capital and uniting its own body of Engineers by a local esprit de corps; and again in the difficulty of satisfactorily adjusting the appointments to office in the organization and government of the society.

The attempt to establish a *National* society having thus failed under circumstances which discouraged its repetition, it may have occurred to some that each State might have a distinct society for itself, or that several contiguous States might unite in the formation of one; thus, in the latter case, dividing the Union into groups of States for the purpose. To the first of these plans the objection is that only a few of the larger States are likely ever to possess, at one time, within their limits a sufficient number of Civil Engineers to support such an institution; and that in the composition of this limited number, changes will be frequent, owing to the constant emigration of the members from one State to another. The same difficulty exists though in a less degree in the partial confederation of neighboring States; and indeed it is manifest that any extent of territory less than the whole country must contract the jurisdiction of such an institution, very much to the disadvantage of the objects it is designed to promote. If independant or associated State societies were however formed and found to operate well within their own boundaries, there must still be some means employed to connect their separate action, so as to maintain a mutual intercommunication between them, in order that the individual proceedings of each might enure to the common benefit of the whole—and this federative connection would be as essential to the advancement of their common objects, as our general government is to the promotion of the general welfare of the republic of which we are the citizens. This correspondence between the State societies would, for the most part be epistolary, and carried on through their officers; for, the

members at large of the several bodies could no better afford to mingle interchangeably in the meetings of their respective assemblies, than they could come together in the general convention of a National Institute—and intercourse could not be kept up by *delegations*, either with convenience to the deputies or general advantage to their constituents. So then, it would appear that pen, ink, paper and the mails must, at last, be the grand medium of communication among the Profession. Why, then, not take to it at once without a resort to societies difficult to form, expensive to maintain and after all inefficient in their operation?

To the abortive plan of one or more "societies," this interogation presents, as the conclusion following the preceding premises, a very obvious alternative, and one which the Profession has been all along practically employing. Engineers who want information from each other and cannot get it by talking, do it by writing. The improvement by which this most familiar mode of intercommunication is susceptible, and which it is much in need of, is a more general diffusion of its advantages by the introduction of that *system* without which nothing of an associative character can flourish. And of what should this system consist? Of nothing more than this; that a reservoir should be provided into which by the conduits already existing in the mails of the country, every individual of the Profession who has so much as a drop of professional knowledge, may cause it to flow; or, in plain terms, that a Journal should be established as the general organ of the fraternity, to which every one of its members should regard it an imperative duty to contribute paragraphs or pages as his ability and opportunities may permit.

Now there are already several publications founded and maintained for this very object; so that this part of the scheme is no more new than the other, and all that I pretend to, is to point out the capability of this plain, cheap, and long though imperfectly used mode of correspondence to effect nearly all that such a society as was originally contemplated could have accomplished. If I succeed in this I shall, it is true, deserve no more credit than Dr. Franklin merited, when he proved to the Parisians that the sun rose at such an hour and gave light as soon as he was up—but with this I shall be satisfied if the consequences of the demonstration be what I desire.

That an epistolary association of Engineers may become an efficient means of professional intercourse, the following requisites are indispensible.

There, first of all, must be aroused and kept alive in its members, an ardent desire for the advancement of the interests of the Profession in the acquisition and diffusion of science, experience and skill: an active esprit de corps in our ranks, leading to strenuous and united efforts to raise our character as a liberal profession *in our relations to the other professions*. A generous emulation among ourselves individually, entirely free from bitter personal rivalry. The suppression of a hypercritical temper in regard to the *literary* merits of the articles which may appear in our Journal, the substantial information conveyed being looked at *through* the style of its communication

however inelegant that may be, always provided it be sufficiently perspicuous. The best practical Engineers are not always the best writers, and as there is so much of the *mechanical* in our pursuits, we should encourage free communications from those whose calling is entirely of that kind; but who might, if their compositions were too severely criticised, be deterred from giving us the benefit of their knowledge.

To keep under the sensitiveness to be found fault with, which leads to so much personal retort and acrimony in the discussions which figure in professional Journals. We should not wince at criticism however condemnatory, provided it be fair and free from an unkind and caustic spirit.

Sectional and State jealousies, which we all know to have heretofore excited in no inconsiderable degree, must be suppressed, and the whole United States be regarded as our common country. The promotion of national feeling is of prime importance to our object, as it disposes one State to borrow more freely from another whatever may be found of superior merit.

A spirit of frank inquiry into the practice of others, in regard to modes of construction of works and their management, should be promoted; so that no Engineer who has a work to do, or a system of management of a finished work to organize should fail to acquaint himself with the methods used by others in analogous cases. The ambition to be different from all others in our way of doing things is too prevalent. It is a spirit more pardonable than wise; but as it will continue to possess us, the way to gratify it and secure originality in our own productions, is to know all that others have done before us in that department.

Untiring *industry* in collecting and communicating every species of professional information within our reach. We should avail of every opportunity of noting down the facts falling in our way (however comparatively trivial) bearing upon professional principles. These observations should be transmitted to the Journal at our earliest leisure. And in regard to this most meaning word *leisure*, it is necessary that right ideas should be entertained, as wrong ones are so prevalent. The Engineer who waits for entire cessation from professional occupation and care to record his experience for the benefit of others will wait in vain, and do nothing for them after all. Leisure will never come to him even if employment should cease. That suspension of labor generally brings with it a loss of active interest in the concerns of the profession, and the procrastination which prompts him to postpone until an idle hour, his note or his contribution to the Journal founded upon it, will in a majority of cases put off the making of it altogether. The undersigned frankly avows that he speaks in this matter from personal experience.

The Engineer should not wait until he actually and immediately wants information upon certain points; but if anything should occur to make him sensible of the advantage of eliciting, for the common benefit, the experience which may exist in regard to such points, he should at once propound in writing a series of queries, and forward them to the Journal, ad-

dressed to the Profession at large, and calling for answers, which should be promptly given by those who can furnish them.

The information thus asked for should be as *detailed* as possible—vague and general accounts of works are mostly unsatisfactory and of no practical utility. We want to be saved the labor of studying out for ourselves what has been already and successfully carried into effect by others, so that, in all that we do to advance the art of Engineering, our first step may be planted in the last foot print of him who preceded us, and has gone on that track as far as his own purposes required. A vast deal of sterling talent and precious time is thrown away in re-inventing what has been already invented and applied, if we did but know it—and a vast deal of mortification is felt in finding that what we had worked so hard to secure as our own should after all belong to some professional brother who had got the start of us. And as no verbal description of a work is good for much unless illustrated by drawings, these should always be furnished; but as the making of drawings to a scale and in such style as would be creditable to the contributor as a draftsman would generally consume more time than he could command, it should be sufficient for him to send to the Journal a rough sketch exhibiting all the necessary views of the subject, with the required dimensions and explanations, from which a drawing might be made by the professional draftsman in the employ of the establishment and who should be a person of more than ordinary intelligence and skill.

Failure as well as success in constructed works should be communicated to the Profession through the Journal. The experience derived from failure has often been truthfully said to be more valuable than that drawn from success. The latter makes us often too bold; the former keeps us in salutary check and indicates what we are to shun. The making of these experimental defects known to the world will indeed prove the most difficult of our tasks, and will call for much ingenuous candor on the part of those whose misfortune it has been to do that which has undone itself. And, if that high degree of frankness cannot be practised by the authors of the abortive plans, others, who are witnesses of their want of success must not hesitate to report it for the common benefit, however invidious the office. This should be done of course in the most delicate way and the imputation of personal blame be avoided if possible.

Such are some of the general principles which should govern us in the conduct and support of the periodical which should be established as the organ of our profession and the repository of its theory and practice as developed by the united science and experience of the Civil Engineers of the United States.

Now in the execution of this proposed plan of systematizing our epistolary intercourse with each other on professional subjects, how should we proceed? A few suggestions will essay an answer to this question.

*First*—we might set up an entirely new Journal, or *second*, we may select for our purpose one of those already in existence.

Difficulties attend both plans; but the most serious I think surround the former, as it would require another convention of Engineers, the assembling of which would be next to impracticable. Better then undertake the office, invidious though it be, of choosing between the papers now established, and proceed to reorganize and enlarge the one which may be chosen, to suit the object we have in view. The two principal periodicals devoted to the subjects of our profession are the "Journal of the Franklin Institute," and the one from whose pages I am now speaking. Upon either stock might be engrafted the improved scion whose cultivation we propose. In regard to the Railroad Journal it is but fair to say that its original establishment was a generous enterprize, which has been poorly rewarded in the hard struggle for existence which it has maintained for the past twelve years. This publication possesses interest in the fact that its birth and that of the railroad system were simultaneous and their existence thus far coeval. I say nothing of the past conduct of this Journal, except that in the feeble support, professional and pecuniary which it has for the most part received, an excuse might be found for a much less spirited and able management than has marked its course.

Of the Journal of the Franklin Institute I need say no more than that it is a paper whose high reputation, enjoyed ever since its institution fifteen years since, is most fully merited. This periodical has possessed a great advantage over those conducted by individual enterprize, in being the organ of a scientific institution whose members have individually and collectively contributed to its support, and whose funds have supplied the occasional deficiencies of its subscription list. By these means it has been enabled to sustain itself and its publication has been uninterrupted and regular. Without being backed by the resources of the society with which it is connected, I am informed, however, that it must have failed for want of pecuniary support, which conclusively shows, that no paper of this kind, dependant upon the punctual payment of subscription dues, can be kept up for any length of time, unless it be propped by such a patronage as I trust can be brought to the Journal which is now suggested as the medium of our professional correspondence.

Between these two publications, it seems to me, our choice must lie. They are published in the two chief cities of the union, with almost equal advantages of position in all respects. I shall, as an individual be satisfied with the selection, let it fall upon either of the two; but upon *one* it must, I think, be definitely settled; for they cannot serve together in the office proposed. The necessity of unity in the organization suggested, is manifest. Interrogatory and reply must pass through the same channel. The article and the criticism of it must appear on the same pages. Of this an illustration was furnished in a number of the Railroad Journal published some months since, in which an author complains that his composition, having first appeared in the Franklin Journal, was commented upon in the other, leaving the separate readers of each acquainted only with the *pro* or the *con*, (as the

case might be) of the question discussed, instead of having both *pro* and *con* before them in one view. Besides, it is essential to the unity and harmony which, it is believed, would be imparted to the actions and relations of the profession, that but one centre should exist from which the beams of intelligence should be radiated or reflected to every point of the professional circle of knowledge. To borrow a geometrical metaphor, the ellipse, with its two foci, would not, it is thought, be the right figure for the purpose. At the same time I must not be understood as presuming to insinuate that the one not chosen for this purpose is to become extinct or to be less active and useful in the course of scince than it may be at present.

The practical difficulty of a selection between these two periodicals or any others that may be named, may however, and in truth does, appear rather appalling. Upon the scheme presented no such concert of action as would attend the proceedings of a convention can be expected. Every individual Engineer whom these suggestions may reach and who thinks them worth acting upon, must express his opinion and cast his vote in the dark. This will be the condition of the question at first; but should there be as it is earnestly hoped there may be, *a general expression of the sentiments of the members thereupon*, light may soon arise out of the darkness, and the conflicting currents of the opinions at first expressed may ere long take a decided set in a direction which shall indicate what is the mind of a majority of the Profession in the matter. From chaos order may come forth. I apprehend more danger from apathy than from anarchy in the republic.

Let us then suppose the effervescence of opposition to have subsided and the "Organ" to be agreed upon. Now to support it upon the principles above developed we must make up our minds to pay well for it. And this we can afford to do, if we consider what the expense would be of attending even the annual meetings of a society, in the place of which our subscriptions to the Journal would stand. Every Engineer who would, if a society were not, (for other reasons) impracticable, attend its meetings and spend from $50 to $100 per annum in doing so, would cheerfully contribute the one-fifth or two-fifths of those sums to a Journal, *if he believed it would accomplish as far as the case permitted, the object of such a society.* Of the extent of this class of Engineers I have no means of accurately judging, but will suppose it might number 100—whose aggregate subscription at $20 per annum would amount to $2000. And further, may not the Profession for the purpose of estimating the revenue of such a Journal, be divided into classes? and, if this be allowable, we may then suppose a second class (I speak in no spirit of invidious comparison) which would pay $10 per annum each, and which might number 200, and, if so, would bring in a further sum of $2000. A third class, consisting of men of general science and information, not having a sufficient interest in the work to go to the same lengths in its support as professional Engineers, might pay $5, and as this class would be a pretty large one we might set it down at 500, in which case it would yield $2,500 per annum. A fourth and final class

might be presumed to consist of contractors, operative mechanics and others who might not, on the whole, be willing to give more than $3 per year; and if they amounted in number to 1000 more, would contribute $3,000. The sum of the contributions of the four classes would then amount to $9,500 per annum. The number of subscribers, supposed as above to be 1,700, divided into this assumed revenue, would give $5·59 as the average subscription for each person. Now although I have assumed the preceding numbers almost at random, they have brought out a result but a little within the subscription price ($6 per annum) of just such a periodical as I have in view, viz: the British "Civil Engineer and Architects' Journal." If that price be sufficient for such a work in England, it would be so, *a fortiore*, in the United States, where books and printing of every kind are much cheaper.

Now it may appear to my readers that this graduation scheme is, at best, a doubtful one, and that no Engineer, however warm his professional zeal and full his professional pocket, would be content to pay $20 or $10, or even $5 for what another class of subscribers got for $3; and this may be so, though I do not think it ought to be so, if the great object in view is exclusively regarded, and fully appreciated, that of maintaining the only or the best substitute for the admitted desideratum of a society of Engineers, at an expense, not one-fourth as great as the latter, even to the most liberal contributor to the "Organ," holding its place. The only way I see to get over this stumbling stone would be to furnish each subscriber with a number of copies proportional to the amount of his subscription; and to do this there must be issued as many as the lowest assumed subscription of $3 would produce by dividing it into the supposed aggregate receipts of $9,500. This would give a quotient of 3166 as the necessary number of copies, or in round numbers 3200, of which each $20 subscriber would get 8 (throwing off the fraction of $\frac{2}{3}$)—each $10 would receive 4 (throwing off the fraction of $\frac{1}{3}$) and each $5, be furnished with 2 (adding the fraction of $\frac{1}{2}$) and the remainder with a single copy each. Then the question is, could 3200 copies of such a Journal be issued for the sum of $9,500?

To enable me to answer this question I have obtained the assistance of a person of experience who has prepared for me a detailed estimate of the annual cost of publishing a periodical (such as I had in view) of 32 pages per month of the form and size of the "Civil Engineer and Architects' Journal," and to be executed in equally good style and as fully illustrated with engravings. The estimate is as follows, for the monthly publication of 1500 copies.

*Mechanical department*, viz.

| | |
|---|---|
| Composition, press work, paper, covering, stereotyping and contingencies, | $2038·08 |
| *Publishing department*, viz. | |
| Advertising, commissions, envelopes, postage, porterage, publisher, clerk, etc., | 2300·00 |
| *Editorial department*, viz. | |
| Editor, periodicals, lithography, cuts and engravings, | 2360·00 |
| Making the total estimated cost of 1500 copies | $6698·08 |

| | |
|---|---|
| This includes $568·32 for stereotyping, and the expense of 1000 copies more from the plates is set down at | 1679·02 |
| So that the cost of 2500 copies would amount, probably, to | $8267·10 |
| The cost of stereotyping being here estimated at $1·68—to make up the required number of copies we add 700—which at that rate would amount to | 1176·00 |
| And the probable cost of 3200 copies would be then | $9443·10 |

which is a little within the supposed amount of subscriptions.

But what, it will be said is the $20, the $10, and the $5, subscribers to do with his surplus copies which are but so much waste paper to him? Not so. He may find it easier to get rid of them than might be supposed, and that without committing them to the flames or sending them to the trunk maker. The state of things I have assumed is intended to exhibit only the outset of the scheme. Each subscriber who receives more than one copy becomes at once an agent for procuring more subscribers to participate with him in his burthen. Thus the number of subscribers may ultimately come to equal that of copies published. What cannot be disposed of in this way can be readily parted with to friends at home and abroad, with the pleasure which every professional man takes in such courtesies, and for which also he is usually rewarded by an exchange of something of more substantial value to him than even the satisfaction of the gratuity. Besides the value of the "back numbers" of such a work as would be the offspring of the system proposed, would annually increase as the number of subscribers augmented; and sooner or later all the originally extra copies would be absorbed by purchases to make up complete sets of the publication.

I now respectfully commend the subject to the attentive and *early* consideration of the Profession, in the earnest hope that it may be taken up and discussed with an animation indicative of a general and cordial interest in what so vitally concerns our wellbeing as a body. I owe it to one of the most frequent and valuable contributors to our professional literature (John C. Trautwine, Esq.,) to acknowledge his suggestion of the idea upon which I have enlarged, contained in a note to a communication of his which appeared a year or two since in the Journal of the Franklin Institute—and I trust to find in him a zealous promoter of the plan. At the same time it is due to myself to say that the design of an epistolary association acting through a medium such as I have described, occurred to me soon after it became apparent that a society of the ordinary organization could not be formed; and that the first paragraphs of this article were penned at that time and afterwards neglected, under the press of other engagements. In the canvass of the subject which I trust this appeal will produce and in the criticism to which it may be exposed I deprecate nothing but the indifference which would permit the scheme to sleep without a persevering effort on the part of the Engineers of the United States to realize the benefits it may be capable of conferring.

BENJ. H. LATROBE,
*Civil Engineer.*

*Baltimore, Oct.* 10, 1843.

For the American Railroad Journal and Mechanics' Magazine.

COST OF TRANSPORTATION ON RAILROADS. BY CHARLES ELLET, JR. CIV. ENG.

(Continued from page 25 Vol. I, Third Series.)

The importance of ascertaining the expense of transportation on railroads, to a large portion of the population of this country, has led to many discussions, and many inquiries, with a view to its determination. No general method has, however, yet been produced, by which it can be ascertained with any tolerable degree of accuracy. The difficulty appears to have arisen, in a great measure, from the fact, that these expenses consist in a variety of elements, which increase and diminish in value by different laws, and at rates which depend on the combinations of these elements in each particular case. It has, also, to some extent, grown out of the fact, that during the progress of this system, every year has produced some new work of improvement, which has supplied new data to calculators—and, unfortunately, data which have preceded the effect of the two greatest causes of expenditure—the destruction consequent on use, and natural decay. Without referring to another difficulty—the extravagant estimates of the friends of particular projects, and, sometimes, the gross misrepresentations of the enemies of others—we see that the subject is much too complicated to be unravelled without close study, and mature reflection. To make a general solution, we have, obviously, to allow for differences of grade, differences of tonnage, differences between the amounts of travel, and have due regard to the length, and even the age of the improvement.

Now, to attempt to go through this whole subject, and produce and analyze the data on which are founded all my conclusions, would require much more labor than I have a disposition, at this time, to appropriate to the question. What I now propose to do, is again to point out the LAW which governs railroad expenditures, and to fix, with greater accuracy, the values of the constant coefficients than was practicable when I first offered the formula which are here repeated.

It is my intention to submit, in the first place, the law which governs the expenditures on a *new road*, and attempt to offer a reasonable explanation, and a just estimate, of the difference between the expenses incident to a new road, and an old one. If my method be true, the reasons, and the values which I assign for this difference, must be obviously just. The general law must first satisfy the mind, and the law of increase, in passing from a new to an old road, must likewise be rational and convincing. If, after this preparatory evidence, I bring forward a certain new road of great length, and show that the calculated cost corresponds well with the actual result, it will certainly be a strong confirmation of the general correctness of the method. But still, for a prudent man proposing to risk his fortune, this alone ought not to be sufficient. This particular example might be selected because it was accidentally found to suit the object; he would have a right, therefore, to call on me to produce a *short* road, and show that the results still correspond with my calculation. His intellect might not yet be fully satisfied; it would be fair for him to call for another example, in which the trade and travel

were both unusually great, in order to be assured that the method is applicable to works of that character also; and, even after finding this result to be confirmatory of the method, extreme prudence would dictate an additional application to another road with very small trade.

All this appearing satisfactory, he could not well retain a doubt; but, when men stake their fortunes, and the comfort and indulgence of their families on the issue, they have a right—they are bound—to exercise great circumspection. Such a party might, therefore, well call for an application of the method to an *old road*—or to one that has arrived at maturity, at least—in order to see whether his investment is likely to be permanently good.

If this doubt be also satisfied; if he finds that the application may be safely made to a road of this description; if, in addition, it is made to one of this sort with a great trade—next, to one with a small trade—then to one with great travel and no tonnage; afterward to a long one, and, finally, to a short one; to some roads with light, and to others with heavy grades—and, if he find that it gives consistent results in all these varied applications—as a reasonable, and as an intelligent man, he will be compelled to admit, that the method is in accordance with THE LAW, and that its results are the TRUTH.

It is such testimony that I propose to offer the reader, and I solicit his attention in order that he may judge fairly of my consistency—for consistency a test of truth. The following propositions are what I designate as Laws:—

I. The cost of motive power, with engines of the same class, is proportional to the distance which the engines run. The cost per mile is *nearly* the same on roads of all grades*—the difference in expense on roads with different grades, consists not essentially in variations of the cost *per mile run*, but in variations of the number of miles which must be performed to do the same duty.

II. The repairs of the road, with equal trade, are proportional to its length; that is to say *cæteris paribus*, it costs twice as much to keep up a road 200 miles long, as it does to maintain one in the same condition, of which the length is 100 miles; just as it costs twice as much to run engines 200,000 miles, as it would to run the same class of engines, 100,000 miles.

III. The repairs of cars are proportional to the number of tons conveyed, and to the distance to which they are conveyed. It costs twice as much to repair cars which run two millions, as it does those which run one million of miles per annum. Again, it costs twice as much to repair cars which convey 20,000 tons a given distance, as it does those which convey 10,000 tons the same distance. The same principle applies equally to the conveyance of passengers; it applies also to accidents, incidentals, and contingencies—for these things increase with and are proportional to, the increase of business.

* The cost per mile run, with engines of the same class is nearly the same on roads of all grades, but if the engines can obtain full trains, or as much as they can carry, the cost per mile run will be somewhat the greatest on those roads which have the most favorable grades. The cost per mile run will be greater on the Reading road than on any other road in the United States on which fuel is obtained at the same rate. The aggregate cost per mile run—i. e. the aggregate expenses for the year divided by the number of miles travelled, if the work is economically managed, will be likewise greater on this road than on any other, of the same age, in this country.

These may appear like self-evident truths, and they are, in fact, so glaring that they scarcely appear to have been looked on at all. The custom now is to regard the expense of cars as proportional to the distance the *engine* runs. It is here made proportional to the distance the *cars* run. It is customary also to consider the repairs of the road as proportional to the distance travelled by the engine—whereas it is only proportional to the length of the road.

These are simple principles, and such as cannot well be doubted, or denied. It remains to state the values of the constants.

### REPAIRS OF ROADS.

The repairs of a railroad, I have stated, must be divided into two classes —those which are dependent on, and those which are independent of, the amount of the tonnage. Of the first division, the wear of iron depends entirely on the use, and the wear of the wood, but partially on the use. The rotting of timber, the cleaning out of ditches, the repairs of culverts, embankments, etc., are independent of the trade. But these items are not independent of *time;* the expenses of repairs increase but little until the wood in the sills, ties and rails, begins to decay, and require removal, when they usually soon attain their maximum, and afterward diminish, until they reach a second minimum.

The following table exhibits the cost of repairs on six of the most successful roads in this country, which I have purposely selected from different sections. The table embraces three roads of each of the two great classes—three wooden superstructures with plate rails, and three iron roads with T or H patterns.

By casting the eye down the columns, the progressive increase of expenses will be easily recognized. It must be borne in mind, however, that these numbers do not include the renewal of the iron—an item always charged to "extraordinary repairs," or "permanent improvements,"—as though iron rails were ever permanent, or their destruction extraordinary. Eventually, the cost of the new iron passes into capital stock, or funded debt.

*Table showing the Increase of the Cost of Repairs of Railroads.*

| Year. | Permanent road—edge rail. | | | Wooden roads—Flat bar. | | |
|---|---|---|---|---|---|---|
| | Boston and Lowell. | Boston and Providence. | Boston and Worcester. | Utica and Schenectady. | Petersburg road. | South Carolina road. |
| 1836 | --- | --- | --- | --- | $251 | $870* |
| 1837 | $546 | $285 | $206 | $354 | 664 | 880 |
| 1838 | 611 | 411 | 281 | 330 | 542 | 1040 |
| 1839 | 731 | 209 | 405 | 450 | 539 | 982 |
| 1840 | 816 | 334 | 830 | 618 | 794 | 592 |
| 1841 | 1200 | 597 | 784 | 837 | 857 | 547 |
| 1842 | 1350 | 514 | 903 | 935 | | 503 |
| 1843 | | | | | | 375 |

I may add the following notes of the cost of motive power per mile travelled by the engines, which are extracted from documents that were not in my possession when I first stated the cost per mile for passenger engines at 25 cents, and of freight engines at 30 cents:—

* Finished in 1833, when the expenses were very low.

*Table showing the Cost of Locomotive Power for 1842.*

| Name of road. | Miles run. | Expense. Dollars. | Cost pr mile | Year. | Remarks. |
|---|---|---|---|---|---|
| Boston and Providence, | 35,031 | 11,399 | 32½ | 1842 | Freight engines. |
| Boston and Providence, | 77,774 | 23,352 | 30 | 1842 | Passenger engines. |
| Western road, | 397,295 | 84,165 | 21¼ | 1842 | Exclusive of wages. |
| Western road, | 397,295 | 115,000 | 30 | 1842 | Wages included. |
| Utica and Schenectady, | 155,828 | 33,454 | 21½ | 1841 | Exclusive of new eng. |
| Utica and Schenectady, | 155,828 | 52,268 | 33 6/10 | 1841 | Including new eng's. |
| Reading road, | 83,717 | 17,443 | 20 8/10 | 1841 | With new engines. |
| Reading road, | 198,055 | 49,800 | 25¼ | 1842 | New, but heavier eng's |

This table entirely confirms the previous estimate [vol. iv, p. 307.] Another table in my possession [derived from reports of 1842] gives for the average value of repairs of locomotives, 7 cents per mile run; my impression is, however, that this item is worth not less than 8 cents, and that future observation will maintain it, for engines that are not fresh from the factory, at about that average.

We may now pass to the method and the rule which I propose for computing the aggregate annual expenses of a road. In the first number of this investigation, I proposed a formula which was published in this Journal, for determining the value of these expenses—stating, however, that there was no line in the country which had yet exhibited results as favorable as expressed by that formula. The present paper is intended to show these expenses *as they are*; the same formula is used, though the constants are modified to suit the actual condition of the system.

FOR NEW ROADS.

The aggregate annual charges on *new roads** are made up of the following items, viz.:—

For every mile travelled by the engines, 24 cents; for every ton conveyed one mile, 9 mills; for every passenger conveyed one mile, 7 mills; and for every mile in length of the road, 300 dollars, facts which are expressed by the formula,

$$\frac{24}{100}N+\frac{9}{1000}T+\frac{7}{1000}P+300\lambda.$$

where N is put for the number of miles run by the locomotive engines, T the tons nett conveyed one mile and P the passengers carried one mile and $\lambda$ the length of the road in miles.

Now, new engines consume as much, or nearly as much, fuel and oil as those which have been used; and they require the same number of enginemen and firemen. The only reduction in the cost of their maintenance, consists in the item of repairs. The bill for repairs for the first year or two, is only about one-half its mean value; and as the average cost of repairs is about 7 cents per mile run, the aggregate cost per mile run on a road which has passed its fourth year, should be 27½ cents, instead of 24 cents.

The *timber* in the superstructure is worth on the average, from 1000 to 1500 dollars per mile, and lasts from 5 to 7 years. The decay of timber in roads of mature age and provided with a single track, is, therefore, about $200 per mile—so that ordinary repairs on such roads will be about $500 per mile.

The wear of cars after the road has been a few years in operation, is equivalent to about 4½ mills per ton per mile; and on a new road it is scarce-

* I designate as new, roads less than five years old.

ly appreciable. The difference between the perceptible injury to the road and cars, on a new and old road, is about five mills per ton per mile. The rule then is—

FOR OLD ROADS.

For every mile travelled by the engines, (passenger engines 25 and freight engines 30 cents,) an average of 27½ cents; for every ton conveyed one mile, 14 mills; for every passenger conveyed one mile, 7 mills; and for every mile of road, $500.

If the principles and the values here offered be correct, they will stand the test of trial, and in order to make the test the strongest possible, I will add in a subsequent paper an estimate of the probable results on a road in active operation, and the subject of much speculation at the present time, the correctness of which estimate can be verified at the end of the year.

This rule, if applied to the business of a line in activity, will give only those expenses which are usually denominated "ordinary expenses." In order to arrive at the *true cost* of maintenance we have to add, of course, the extraordinary expenses, which we can likewise estimate with some, though not very great, accuracy, by data now supplied by the improvements of the country.

APPLICATION OF THE FORMULA TO ACTIVE WORKS.

I shall apply this method of computation, in the first place, to a railroad in Georgia, 147½ miles long, with easy grades and little business; next, to one in Massachusetts, 156 miles long, with grades of more than 80 feet to the mile, on which the engines travel nearly four hundred thousand miles per annum, and where the trade and travel are both great; I will then apply it to a short road in the State of New York, which carries no tonnage at all, but which derives its revenue entirely from passengers, and which has moderate grades, and a moderate business; next, I will make the application to a road in Maryland 70 miles long, with grades of 84 feet, and which derives two-thirds of its revenue from tonnage. Finally, I will apply it to a road in Pennsylvania 56 miles long, with favorable grades and moderate business—and again to the same road the next year, when extended 38 miles further, and having an increase of business.

The following table gives the length, grades and business of these roads; and, in the two last columns, are placed, side by side, the actual and calculated expenses.

*Table exhibiting the actual and computed cost of maintaining new roads, calculated from the formula,*

$$\frac{24}{1000}N+\frac{9}{1000}T+\frac{7}{1000}P+300k.$$

| Name of road. | L'ngth miles. | Grade in feet. | Miles trav. by engines | Through tonnage. | Through travel. | Expenses. dollars. | Calculated expe. dolls | Year. |
|---|---|---|---|---|---|---|---|---|
| Georgia road, | 147½ | 37 | 152,873 | 10,000 | 12,000 | 109,819 | 106,606 | 1842 |
| Western road, | 156 | 83 | 397,295 | 40,000 | 53,000 | 256,619 | 256,187 | 1842 |
| Syra'se & Utica, | 53 | . | 84,000 | . | 87,881 | 62,325 | 68,662 | 1842 |
| Balt. and Susq. | 70 | 84 | 128,349 | 23,000 | 16,500 | 75,224 | 74,379 | 1842 |
| Reading road, | 56 | 19 | 83,717 | 24,000 | 31,653 | 62,635 | 61,318 | 1841 |
| Reading road, | 94 | | 198,055 | 65,000 | 33,720 | 138,000 | 152,911 | 1842 |

The roads named in this table are all those which have been completed less than four years, of which I have been able to procure the trade and travel, aggregate expenses, and distance run by the locomotive engines for the year 1842. In some of these I have been compelled to deduce the through tonnage from the receipts and prices—the reports giving only the aggregate tonnage;—in general the through travel is given with precision.

The agreement between the actual and calculated results in this table, is most remarkable, and exhibits a degree of uniformity in the administration of the lines, which could not have been anticipated. Indeed it is most probably because the roads are so new that the agreement is so perfect. When they begin to feel the effects of time and use, they will give way unequally, and exhibit much wider deviations from the rule. This fact is exemplified in the following table, which exhibits the results of experience on 11 important railroads, selected from different sections of the country. The roads in this table vary in length from 14 miles to 136 miles; in grades from 10 feet per mile, to 83 feet per mile; in freight from nothing to 94,000 tons; in travel from 7,000 to 180,000 passengers; and in expenses from 30,000 to 225,000 dollars per annum.

*Table exhibiting the actual and computed cost of maintaining roads which have been completed more than four years, calculated by the formula,*

$$\frac{27.5}{100}N+\frac{14}{1000}T+\frac{7}{1000}P+500k.$$

| Name of road. | Year. | L'ngth miles. | G'de. in ft. | Miles run. | Through tonnage. | Through travel. | Actual expen's, dols. | Calculated exps. dolls. |
|---|---|---|---|---|---|---|---|---|
| Bost. and Prov. | 1842 | 42 | 38 | 120,000 | 21,200 | 117,129 | 101,596 | 100,897 |
| Balt. & Wash. | '41-2 | 30½ | | 91,428 | 27,360 | 114,260 | 73,684 | 76,166 |
| Petersb'g road, | 1842 | 61 | 30 | 131,160 | 22,000 | 16,000 | 96,398 | 92,489 |
| Nash. & Low'l, | 1841 | 14 | 10 | 44,040 | 28,663 | 85,737 | 30,708 | 33,131 |
| Balt. and Ohio, | 1842 | 82 | 82½ | 299,617 | 44,477 | 34,380 | 220,135 | 192,925 |
| Ports. & Roan. | 1842 | 79 | | 96,000 | 5,975 | 7,662 | 73,345 | 76,703 |
| Bost. & Lowell, | 1842 | 26 | 10 | 143,607 | 93,927 | 179,819 | 131,012 | 119,409 |
| Phil. & Colum. | 1842 | 82 | 45 | 261,844 | | | 116,000 | 112,979 |
| S. Carol'a. road, | 1842 | 136 | 35 | 260,324 | 27,000 | 24,000 | 225,743 | 213,945 |
| Bost. & Worc'r. | 1842 | 44½ | 42 | 241,319 | 61,911 | 165,720 | 168,509 | 176,815 |
| Utica & Schen. | '41-2 | 78 | | 152,764 | | 114,527 | 154,436 | 143,542 |

[NOTE.—The miles run on the *Petersburg road* are assumed to be the same as in 1841; the tonnage is estimated from the tonnage of 1841, with an allowance for the increased receipts. The results on the *Baltimore and Ohio road* for 1841 are preferred, because those of 1842 are complicated by the extension of the line to Cumberland. The report of the *Philadelphia and Columbia road* contains only the expenses of motive power and repairs; the freight and passengers are conveyed by other parties; we have, therefore, in the formula to make $P=0$ and $T=0$, for this case. The tonnage and travel on the *South Carolina road* are deduced from the printed reports. The actual expenses on some of the lines will be seen to differ from other published statements; this will be found to arise from the fact that these statements contain charges for interest, ferries, cars and motive power on branch roads, which, of course, are rejected in this comparison.]

Here is presented a list of eleven roads, situated in different sections of the

country, and offering every variety of length, grade and business that could be desired, in order to put the formula to the severest test. The greatest difference which is exhibited in the whole list between the actual annual cost of maintenance, and the estimated cost, *is* 12 *per cent.*; certainly no closer agreement could be expected, since the actual expenditures fluctuate to that extent—and perhaps, through wider limits—from year to year; the removals of decayed timber, and various contingencies, being found much more extensive some years than others. In looking over the list I am able to account, in almost every instance, for these departures from the formula, by my personal knowledge of the situation of the line. It will probably be seen on some future occasion, that those roads which now exhibit expenses above the formula, will fall below it for other years—a remark which is applicable to the Boston and Lowell, Baltimore and Ohio, and South Carolina roads. I hope they may never again rise above it.

It is no part of my object to flatter the expectations of railroad companies, but to exhibit to them and the public the truth. To those companies whose works are now new, and who *seem* to be making money, I would suggest the timely formation of a contingent fund, to prepare them for a contingency which will as surely reach them as the next new year. It is bad policy to divide the *annual expenses* as if they were real profits; the money that is earned at the expense of the rails, cars and machinery, should be hoarded to replace those things, and not distributed, as if they were to last forever. It can be shown that every company should annually store away, in times of prosperity, while their work is new, at least 6 cents for every mile travelled by their engines, 1 cent for every ton conveyed one mile, and 200 dollars for every mile of road, to replace decayed materials, and injured iron and machinery. If their profits will not permit that reservation, then the prudent man will avoid their stock; and the company should cut down their expenses to the limit assigned by the trade. Where these expenses do not consist of interest on debt, this retrenchment is almost always possible.

In the first of these tables the Reading railroad appears to escape the application of the rule; the calculated expenses exceeding the actual charges, as stated by the company, some $14,000, or about 10 per cent. There has probably been a division made between the current and contingent expenses on this line; indeed, on inspecting the published exhibit, I find that the whole sum set down for *timber* used in repairing 94 miles of road, including rails, sills, etc., is just $2,431. Now, I know personally, that twice that sum would not pay for the timber required for repairing the bridges alone. The bridge account last year must have amounted to more than $12,000, and seems not to be included in the published statement. This sum being added to the published total, brings the year's expenses up to $151,000, or within 1¼ per cent. of the formula. Perhaps the company regard the loss of a bridge as so extraordinary an occurrence, that it can never take place again; but their report already points to another which is found to be "less permanent than the rest;" and time will show that no part of railway

superstructures will long remain permanent under the action of heavy engines and their trains. Besides, there will be freshets, and tornadoes, and fires; and on a road which has a great many bridges constructed of perishable materials, and which is travelled by 25 or 30 locomotives every day, or about 10,000 trains a year—with engines using pine wood for fuel—many such accidents must be expected. One bridge per annum is a small allowance for the average loss; and if the bridges happen to be fortunate, there will be rotten sills or crushed iron enough to compensate for the difference.

We perceive then that the formula applies also to this road; and I will now insert a table exhibiting its application to all the roads of which I have been able to obtain the amount of trade, and annex a column showing the per centage of error for each; not having the number of miles run by passenger and freight engines separately in every instance, I make use of the mean value 27½ cents per mile run.

TABLE.

| Name of road. | Year. | L'ngth | G'ds. | Miles run. | Through tonnage. | Through travel. | Actual expenses. | Calculated expenses. | Error per ct. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | *Dollars.* | *Dollars.* | |
| Georgia road, | 1842 | 147½ | 37 | 152,873 | 10,000 | 12,000 | 109,819 | 106,605 | —2¾ |
| Western road, | 1842 | 156 | 83 | 397,295 | 40,000 | 53,000 | 256,619 | 256,187 | 0 |
| Syrac. & Utica, | 1842 | 53 | | 84,000 | | 87,881 | 62,325 | 68,662 | +10 |
| Balt. & Susq. | 1842 | 70 | 84 | 128,349 | 23,000 | 16,500 | 75,224 | 74,379 | —1 |
| Reading road, | 1841 | 56 | 19 | 83,717 | 24,000 | 31,453 | 62,635 | 61,318 | —2 |
| Reading road, | 1842 | 94 | 35 | 198,055 | 65,000 | 33,720 | 151,000 | 152,911 | +1¼ |
| Bost. & Prov. | 1842 | 42 | 38 | 120,000 | 21,200 | 117,120 | 101,596 | 100,902 | —¾ |
| Balt. & Wash. | '41-2 | 30½ | | 91,428 | 27,369 | 114,200 | 73,684 | 76,193 | +3¼ |
| Petersburg road, | 1842 | 61 | 30 | 131,160 | 22,000 | 16,000 | 96,396 | 92,310 | —4 |
| Nash. & Low'll, | 1842 | 14 | 10 | 44,040 | 28,663 | 85,737 | 30,708 | 33,131 | +8 |
| Balt. & Ohio, | 1841 | 82 | 82½ | 299,617 | 44,477 | 34,880 | 220,135 | 192,925 | —12 |
| Ports. & Roan. | 1842 | 79 | | 90,000 | 5,075 | 7,662 | 73,345 | 76,703 | +5 |
| Bost. & Low'll, | 1842 | 26 | 10 | 143,607 | 93,927 | 179,819 | 131,012 | 119,409 | —9 |
| S. Carlina road, | 1842 | 136 | 35 | 260,324 | 27,000 | 24,000 | 235,743 | 213,945 | —5 |
| Bost. & Wor'r. | 1842 | 44½ | 42 | 241,319 | 61,911 | 165,720 | 168,509 | 176,831 | +6 |
| Utica & Schen. | '41-2 | 78 | | 152,746 | | 114,687 | 154,436 | 142,842 | —8 |
| Phil. & Colum. | 1842 | 82 | 45 | 261,744 | | | 116,000 | 112,979 | —2½ |
| Aggregate, | | 1251 | | 2,886,292 | T'ns 1 mile 33,300,560 | Pas. 1 mile 56,633,722 | 2,109,188 | 2,074,512 | |

NOTE.—[By "through tonnage" and "through travel," is to be understood the whole number of tons and passengers carried one mile, divided each by the length of the road in miles. It is much to be regretted that companies do not give these facts in their annual reports.]

One word more in reference to this table. I offer here a list of 17 railroads, presenting almost every conceivable variety of length, grade and character. It is not a *selected* table, but contains the results of one year's operations on *every* road, without exception, concerning which I have been able to obtain the necessary data—materials which have only been procured by dint of great exertion. It will be seen that the management upon these various lines is very nearly uniform, and that they are *all* obedient to the *law*. The greatest departure from the formula is 12 per cent.

Now, this list embraces roads which are situated in every one of the seaboard States from Maine to Georgia; the aggregate length of line exhibited is 1251 miles; the engines traverse annually a space of 2,886,300 miles, and they carry no less than 33,360,560 tons, and 58,633,722 passengers 1 mile. The aggregate ordinary expense of maintaining this length of line, and accommodating this amount of tonnage, is actually $2,109,188 annually, and the calculated expense $2,074,512. The difference between the calculation and the fact is $34,676, or less than two per cent.

I conceive, therefore, that I have authority sufficient for announcing this formula as expressing the general law of railroad expenses—a law to which all the roads in the country are obedient. If stronger evidence of its correctness could be offered, I know not in what it would consist.

It is in vain to urge here that a certain road has peculiarly steep, or peculiarly light, grades, which should exempt it from the application of the rule. The formula which I announce, accounts for these differences. When the grades are easy, the engines make fewer miles, and the rule looks only to the miles.

There is yet another point of great importance connected with this subject, which ought not to be overlooked, viz., the "extraordinary expenses." It is the custom among too many of the parties interested in the railroads of this country, to look upon the suggestion that iron may be worn out, as a thing so chimerical and visionary, as to be entirely unworthy of their sober thoughts. In the course of a few years they are surprised by the fact—the certainty—that money must be raised, for that their iron must be renewed. Instead of being warned by experience, and commencing immediately the work of retrenchment, and the provision of a surplus fund to meet the recurrence of the contingency, they look upon it as extraordinary in the extreme—a sheer accident, which cannot occur again, or which can be warded off by a heavier iron. Experience and common sense teach that heavier iron will be attended with heavier expense; but they have *not yet* taught that the wear will be less. A heavier rail may longer resist a given trade; but will each dollar put into the heavy rail go farther? This however, is a subject which must be reserved for a future number of the Journal.

(To be continued.)

The following communication from Mr. Whittle is worthy of consideration. Whatever changes in the details of his plan circumstances may dictate, the general principle is a good one and should be in more frequent operation than at present. The suggestions of Mr. W. are not *trifling* and we should be most happy to receive many more such *trifles* from him and from others of the profession.

For the American Railroad Journal and Mechanics' Magazine.

In my last annual report to the Monroe railroad company, of Georgia, I proposed the following remarks, which if carried into use, I feel confident would add much to the present prosperity of railroads and advance the interest of their owners.

1st. To encourage planters, who forward their freight, also to travel on the road, give them $\frac{25}{100}$ of the amount of their *freight paid*, in tickets, which tickets will be received for the fare of themselves and families during the year in which they are issued, one-half being paid each time *in cash*. Thus, A sends freight over the road, amounting to $100, which he pays in cash; the railroad company then furnish him with tickets to the amount of $25, which will be received from him or his family for *fare* when they travel, one-half the fare each time being paid *in cash*. The tickets should not be transferable and if not used the year in which issued, should be void.

2d. Many of our roads, in the south at least, have been under weigh for years, without paying the shareholders any interest; during which time, they have had to pay customary charges when they have used it in any way. I would propose that tickets be furnished them each year, till their investment pays an interest to the amount of one-fourth of the interest on their stock, which would be received as above, and that they might also apply to freight on goods as well as fare for passage, which alone was intended for the planter.

I speak from experience and feel very confident that these two suggestions, trifling as they may seem, if carried out, will add greatly to the use of public works and receipts of the companies, especially when the stock is owned by persons living along the line of road. The proportions to be given in tickets, of course, would be varied to suit each case.

*September*, 1843. L. N. W.

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For the American Railroad Journal and Mechanics' Magazine.

MESSRS. SCHAEFFER & MINOR,

The article under the head of "Revolving Steamer," in the September number of the Railroad Journal, describes, I think, not exactly but very nearly a machine which was invented some years since by J. N. Pomeroy, Esq. of Burlington, Vt., a description of which he communicated to, and was published in the Railroad Journal. I do not recollect the year, but it was near the commencement of the Journal. If upon examination you consider me right in my conjecture, I will not insist on your "yielding the editorial pen and scissors," provided you will apprise the New Orleans inven-

tor through your columns that he has probably been anticipated in his discovery. FULTON.

This communication came to hand too late for a reference to the article referred to. A notice will appear in the next, and if our correspondent thinks he has the better of us we *will* yield him our editorial "pen and scissors."

## ENGINEERING.

We learn with pleasure that Mr. *Edwin F. Johnson*, and Mr. *William R. Casey*, Engineers well known to the readers of the *Journal*, have established an office in this city where they will devote their attention to the numerous works which *ought* to fall within the range of the Profession, and which indeed constitute its main occupation in Europe.

Strange as it may appear, there is not an office in this city where persons can obtain the advice and assistance of experienced Engineers in the numerous instances where such aid is obviously wanted. These subjects are alluded to in the circular, a copy of which accompanies this number, and again more briefly in their advertisement.

We called attention sometime since to this view of the duties of the Profession and still believe that, by making proper exertions throughout the country, all its *permanent* members would soon find profitable and steady employment. Nothing would conduce more to this desirable end, than the simultaneous establishment of similar offices in all our main cities by men of undoubted skill and character. We shall be happy to give all the assistance in our power to increase the usefulness of the Profession, and hope soon to see the advertising columns of the Journal adorned with similar notices of Engineers in different parts of the country bringing their claims prominently yet fairly before the community.

## IRON STEAMER ON LAKE ERIE.

We extract the following from a letter recently written to a friend in this city by a young gentleman in the service of the government, from Erie, Pennsylvania.

"Our iron steamer is fast progressing. I was really surprised at the foresight and ingenuity of Mr. Hartt, the constructor. Nothing came amiss, all the 100,000 holes fitted, and very few indeed were to be drilled. One would think he had built fifty iron vessels instead of this the first. The strains are all counteracted with great judgment, and in reading works on the subject, published since she was drafted, there are some new suggestions which he had before adopted."

It would gratify us if Mr. Hartt or the young gentleman above alluded to would send us, for publication in the columns of the Journal, a detailed description of the plan of construction of the steamer mentioned, and the machinery connected therewith; also a description of the performance of the vessel when put afloat.

Information of this description cannot at the present time be too widely diffused.

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ACCIDENTS UPON RAILROADS.

In our number for September, I took occasion to refer, in a manner somewhat pointed, to the frequent occurrence of accidents upon railroads. To those who have been familiar with the course of this Journal in relation to the railroad cause, during the past twelve years, I deem it altogether unnecessary to say more than that those remarks were made with a single eye to the *safety* of those whose business places them within the reach of injury from such casualties, and of course, therefore, to the *interest* of the proprietors of railroads. There was no intention to single out any particular road for censure, but to speak of the most recent accidents as the information before the public seemed to call for, with a view, or in the hope of calling that attention to the subject which its vast importance imperiously demands. Whether they have had the desired effect to arouse the attention of others who have experience in the management of railroads, and the ability to point out the *cause* and suggest a *remedy* for accidents, or not, is now of little importance, inasmuch as the subject has been taken hold of by one who is evidently familiar with it, as will, I think, be seen from the communications signed "T," in our last, present, and succeeding numbers, having now two numbers in hand, which we received too late for this number, from the *Balt. Amer.*, to, and upon which, we ask the special attention and comment of our readers. Let those whose interest is so intimately connected with this matter give it their early attention, and if need be, apply to their respective legislatures for such additional laws as may be necessary to prevent the remaining of cattle upon railways, for the right of way for which, most of the companies have been compelled to pay more than the value of what they occupy. Let the travelling community also, who have what may be termed a *life and limb* interest in the establishment of a thorough system of police for the management of, and prevention of accidents on railroads, urge upon their representatives the *necessity* of such laws as will secure its safety and protect the rights of those who have invested their capital in the construction and management of railroads; an investment which has thus far at least, contributed far more to the interest of those who are *not* than than those who *are* stockholders. D. K. M.

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The letting of the Mad river and lake Erie railroad, from Tiffin to Carey —a distance of 16 miles—took place on the 26th ult. We learn from the Urbana Citizen that the contract for the entire work was given to Mr. Reed, of Tiffin, at $48,000—about $3,000 per mile.

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## CONTENTS:

AMERICAN

# RAILROAD JOURNAL,

AND

# MECHANICS' MAGAZINE.

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For the American Railroad Journal and Mechanics' Magazine.

## COST OF TRANSPORTATION ON RAILROADS. BY CHARLES ELLET, JR. CIV. ENG.

(Continued from page 349.)

### REPAIRS OF ENGINES AND CARS.

It is the custom of many companies to publish the cost of repairs of their cars and engines in a single item, so as to make it impossible for the reader to determine, from their accounts, what portion of the bill was created by the engines, or the difference between the repairs due to different sorts of cars; but still an industrious investigation of the subject gives us facts enough to estimate these separate items for ordinary cases, with all desirable accuracy. I have stated in a former paper that the repairs of burthen cars are worth, on the average, 4½ mills per ton per mile; and that the repairs of the engines averaged, during the year 1842, *seven* cents per mile run. I have also observed that the repairs of passenger cars vary from three-fourths of a mill to a mill and a half, and sometimes exceed 2 mills per passenger per mile. If these facts—all of which enter into the formula which I have offered for the determination of the aggregate annual expenses of a railroad company—be well established, they will not only stand the test of trial for the aggregate, but they will apply in detail. Not only should the formula for determining the aggregate expenses be correct, and correspond with actual results—as we have seen—but the separate items of which it is composed, must, likewise, bear the test, and give results in agreement with the average results of experience.

It is not pretended that a formula could be offered which would show the exact cost of every item of every company for every year—because the actual expenditures due to each item fluctuate from year to year; but it is maintained that these fluctuations are above and below a certain average line, from which they may depart towards either side for a certain time, but to which, and beyond which, on the opposite side, they are as sure to come as the pendulum is sure to approach the vertical in its vibrations. Although it was not my intention to enter so minutely into these details, probably

more confidence will be yielded to my statements when the data on which they are founded are presented. These data, for the repairs of engines, are exhibited in the following

*TABLE.*

| Name of roads. | Year. | Miles run by engines. | Cost of repairs of engines. | Repairs per mile run. | Remarks. |
|---|---|---|---|---|---|
| | | | *Dollars.* | *Cents.* | |
| Phil. Wilm. & Balt. | 1842 | 177,859 | 17,071 | 9·9 | Old road. |
| Western road, | 1842 | 397,295 | 24,177 | 6·1 | New road. |
| Georgia road, | 1842 | 152,873 | 10,155* | 6·7 | Ordin'y & extr'ny rep's & improv'ts. |
| Baltimore & Susq., | 1842 | 128,349 | 7,193 | 5·6 | New road. |
| Utica & Schenec., | 1842 | 150,000 | 10,346 | 6·9 | Passenger business. |
| Baltimore & Ohio, | 1841 | 299,617 | 20,640 | 7·0 | Old roads in good condition. |
| Baltimore & Wash. | 1842 | 95,817 | 7,973 | 7·2 | |
| Philad. & Columb., | 1842 | 261,744 | 21,915 | 8·4 | Genr'ly fre't. bus'ns. |
| Boston & Provid., | 1842 | 112,805 | 7,257 | 6·5 | Old roads in good condition. |
| Baltimore & Ohio, | 1843 | 509,765 | 35,941 | 7·0 | |
| Wash. & Baltimore, | 1843 | 96,716 | 6,714 | 7.0 | |
| | | 2,382,840 | 169,380 | Av7·1 | |

This table exhibits the cost of repairs of engines which have traversed a space of 2,382,840 miles; and shows that the average is within one-tenth of a cent, per mile run, of the mean value at which I had stated it. It is my impression, however, that the average on these same roads will be greater for the year 1843.

Now, if we call N the number of miles travelled by the locomotive engines; T the number of tons of freight carried one mile; and P the number of passengers carried one mile, the average aggregate cost of repairs of passenger and burthen cars, and locomotive engines, will be shown, very nearly, by the formula,

$$\frac{7\,N}{100}+\frac{4.5\,T}{1000}+\frac{P}{1000}$$

By expressing the cost of repairs in this way, we are able to determine, at once, the expenses of repairs for an entire train composed of either description of cars, or of both sorts, combined in any proportions.

Although this, and all my other, estimates might be much strengthened, by bringing forward facts resulting from former experience, I prefer, with one or two exceptions, to limit my examples, on this occasion, to those works of which I have obtained authentic information for the year 1842. Of course, I exclude those lines which have been so recently completed, as to require no repairs at all for cars.

The following table presents the number of miles run by locomotive engines, and the number of tons and passengers carried one mile on eight railroads for the year 1842, and two for 1843—which have been recently

* This company have added to the usual division of their expenses into ordinary and extraordinary repairs, the new classification of "improvements to engines;" not being able to conceive that a small stock of engines could run 153,000 miles, and be materially improved by it, I regard these "improvements" as expenses.

published;—and in the two last columns will be seen the actual expenses of repairs of cars and engines, and the expenses of the same computed by the formula.

*TABLE.*

| Name of road. | Year. | Miles run by engines. | Tons carried one mile. | Passengers carried one mile. | Actual cost of repairs. | Computed cost of repairs. |
|---|---|---|---|---|---|---|
| | | | | | *Dolls.* | *Dolls.* |
| Petersburg road, | 1842 | 131,160 | 1,342,000 | 976,000 | 16,513 | 16,196 |
| Boston and Providence, | 1842 | 120,000 | 890,400 | 4,919,418 | 13,506 | 17,326 |
| Baltimore and Ohio, | 1841 | 299,617 | 3,647,093 | 2,495,911 | 45,534 | 39,881 |
| Baltimore and Ohio, | 1842 | 334,519 | 3,985,425 | 2,738,779 | 44,568 | 44,189 |
| Baltimore and Ohio, | 1843 | 509,765 | 7,109,310 | 6,062,455 | 62,862 | 73,738 |
| Baltimore and Wash., | 1843 | 96,716 | 805,429 | 2,646,719 | 17,453 | 14,801 |
| Baltimore and Susque., | 1842 | 128,349 | 1,610,000 | 1,165,000 | 13,370 | 17,390 |
| Baltimore and Wash., | 1842 | 95,817 | 877,138 | 3,188,948 | 17,053 | 13,864 |
| Utica and Schenectady, | 1842 | 150,000 | | 8,413,704 | 18,842 | 18,914 |
| Boston and Lowell, | 1842 | 143,607 | 2,442,102 | 4,675,294 | 28,816 | 25,716 |
| Georgia road, | 1842 | 152,873 | 1,476,000 | 1,770,000 | 19,899 | 19,107 |

On inspecting this list we will observe that the actual charges on some of the roads are a little above, and on others a little below, the indications of the formula—but that the deviations are in no instance too wide to render the rule, as far as it goes, a safe test of the value of an investment. The actual* cost on the Baltimore and Ohio railroad falls considerably below the computed cost for the year 1843. In 1842 the agreement was very close, and in 1841 the result was nearly as much above as that of 1843 is below the rule. Indeed, in 1841 the sum of $9,766 was expended for *new* burthen and passenger cars, in addition to the $45,534 charged to repairs of cars and engines. The aggregate expenses for repairs of cars and engines, on that work, for the three years amounted to $152,964—and the expenses calculated by the formula to $157,808. If we add the sum paid for *new cars*, to the actual cost of repairs, the actual expenses, for the three years, will be $162,730, or 3 per cent. above the computed expenses.

The formula simply exhibits what it is intended to show—the average for a succession of years. I do not include the Boston and Worcester road in this table, because the result on that work is entirely anomalous. For previous years the agreement between the calculation and expenses was sufficiently close; but in 1842 there was a material increase of business, an extraordinary reduction in the expense of repairing the cars and engines, and a simultaneous augmentation of the capital—or charge for construction—of $390,000. I am obliged to suppose that new cars and engines were added to the line, and that a portion of the business was performed by new stock.

We may now pass to another very important division of railroad expenses, which are usually, though very improperly, denominated "extraordinary expenses." I refer chiefly to the

* The cost of repairs of locomotive engines for this road, for the year 1841, was 9 1-2 cents per mile run, and in a space of seven years, from 1835 to 1841 inclusive, the engines performed an aggregate distance of 850,809 miles, at an aggregate cost of $84,183; or within a fraction of 10 cents per mile run. The repairs of cars are fluctuating, but the average is in accordance with the formula. This road is not an exception to the rule, though the formula does not apply for the year 1842.

WEAR OF IRON RAILS.

There is, perhaps, no subject of interest to the engineer which has attracted less serious attention, or has been more vaguely and indefinitely considered, than the wear of railroad iron. Instead of attempting to find some correct and rational measure of this wear, the public, and in a great measure, the profession also, have persisted in regarding the visible destruction of the iron on roads which have been some years in operation, as a consequence of the inferior quality of the particular specimen, or of the inadequate strength of the particular pattern. It is the custom to say that the mashed and splintered iron of the Camden and Amboy, and Columbia roads was bad; but no argument has ever been adduced to show that good iron, in the same situation, and subjected to the same sort of treatment, would do better.

So long as railroads happened to occupy positions where they would be used for the mere conveyance of the travel, and a few thousand tons of goods, between adjacent cities, the durability of iron was a question of subordinate interest. An engineer could be satisfied that his rail would last 10 or 20, or 30 years, and could generally count on a sufficient increase of business consequent on the increase of population, to compensate for its destruction in that space of time. But railroads are now projected to take the place of important canals, and to furnish the means of transport for the heavy products of the earth at exceeding low rates. The question assumes, therefore, another aspect. The trade of the Erie canal in New York, and of the Schuylkill Navigation in Pennsylvania, may be estimated at 800,000 to 1,000,000 tons per annum; and there is no railroad in the United States worked by steam power, which accommodates more than the one-ninth, or one-tenth, of this amount, with the exception of the Reading railroad, which has not yet been long enough in operation to yield any useful practical results.

The common half-inch flat bar, under ordinary circumstances, is adequate to the transportation of about 150,000 tons of freight. Such a bar on the Petersburg road, where the freight amounts to some 25,000 tons, would resist the wear of six years' business; but if one year's trade of the Schuylkill canal were poured along it, the iron part of the track would need entire renewal *six times in one year.*

The same remark is applicable to any of the same sort of wooden roads in the country. They would all bear about 150,000 tons net, drawn at the usual speed of ordinary freight engines, but would be completely destroyed by about *five weeks' business* of the Schuylkill Navigation, in the season of active trade.

It must be admitted that we have not yet sufficient data for estimating, with entire certainty, the probable durability of many varieties of rails. We have, however, data sufficient, if we use it properly, to make a much nearer approximation than is generally supposed to be practicable. The durability of the half inch plate rail can be determined with all desirable

accuracy, and we can judge from analogies, which the problem presents, the probable wear of other patterns. Great errors have been committed in the consideration of this subject, by overlooking the fact that the progress of the wear is rarely ascertained, or, in the least, appreciated, until the rail is destroyed. The *annual* charge for iron is very small, because, in general, the track does not appear to give way until it is nearly unfit for use. When repairs really commence, the destruction is so far advanced that the iron must be renewed; and if the directors assert, as they usually do, in their next report to the stockholders, that experience has shown that the original iron was very bad, and has all been crushed, the explanation is satisfactory, and the cost of the new iron is forthwith charged to the account of construction.

We accordingly find, in looking through the reports of railroad companies, that the average annual increase of capital, generally exceeds the dividends even of the most successful enterprises: and *there is not now to be found in the country a single road which has renewed its iron out of the proceeds of transportation.* While the trade continues to be small, and this extraordinary outlay is needed but once every six or eight years, the self-deception can be practised with considerable success. But there are now works constructed which are intended for a very great business, and and which will reduce the extraordinary charge for renewal of iron down to a very ordinary circumstance. The Reading railroad is contemplated for the conveyance of the present trade of the Schuylkill canal — from eight to nine hundred thousand—and which will very soon reach one million of tons—and should the experiment succeed, *the cost of iron will be more than equal to the entire renewal of a single track every year.* The question of wear, is, therefore, of immense importance, and can no longer be lightly disposed of by companies of this class.

This, as every other item of railroad expenses, is subject to a certain law, which must be recognized before we can make any effectual progress in our investigation.

The destruction of iron depends on the grades of the road, on the tonnage, and on the travel. Every ton of freight that passes produces a certain amount of injury; every passenger car and every passenger does some injury, and every engine that traverses the line produces its share of mischief; but the number of engines that traverse the road, in conveying a given amount of tonnage, depends on the limiting gradient—and, consequently, the destruction of iron, *cæteris paribus*, is greatest on those roads of which the grades are most unfavorable to the useful effect of the power.

If we call N the number of miles travelled by all the engines on the line; T the number of tons net conveyed one mile; and P the passengers conveyed one mile, for one year, then

$$a\,N + b\,T + c\,P,$$

will be the form of the expression which represents the amount of injury which the iron has sustained—$a$, $b$, and $c$, being constants to be supplied by

experiment. It is assumed, of course, that the weight and form of the rail, as well as the weight, construction, and velocity of the engines, are uniform.

The point, now, is to determine the values of the coefficients, $a$, $b$, and $c$. For this purpose I take, in the first place, a road on which engines are not used, and but few passengers are conveyed. The wear of iron on such a road gives us the value of $b$, or the injury done by the tonnage.

There are two works of this description of which we can find published reports, and which have been long enough in activity to destroy a portion, or the whole, of their iron.

The *Chesterfield railroad*, in Virginia, constructed with a flat bar, and using horse power and light cars, has required, for some years past, about $200 per mile for new iron, to replace that which is destroyed by the passage of an average trade of about 50,000 tons of coal. The destruction is here equivalent to *four mills* per ton per mile.

The *Mine Hill and Schuylkill Haven railroad* was originally constructed with a flat bar, and six miles in length of the road had been renewed with a heavy edge rail, before 400,000 tons had passed along it. Assuming the value of the flat bar at $60 per ton, or $1200 per mile, which is below its present value, and that the iron was worn out by 400,000 tons, the result will be three mills per ton per mile. But this road is provided with a double track, and the track which was destroyed was not used by the ascending cars.

The injury produced by the empty cars is certainly more than one-third of that effected by those which are loaded; and the result on this road, therefore, corresponds very closely with the previous example. The wear then obviously will not be less than four mills on a road sustaining locomotive power—where the velocity is much greater than on the Chesterfield and Mine Hill roads.

I will not, therefore, be above the mark in assuming $b = .4$ mills.

The flat bar on the *Petersburg road* may be considered to have been worn out in six years, by use which was equivalent to 12,000 trips of locomotive engines; 130,000 tons of freight, and 100,000 passengers carried over each mile. If we consider the injury caused by cars carrying five passengers, equal to that produced by those carrying one ton of freight, and the value of this iron equal to $1200 per mile, we shall have

$$b\,\mathrm{P} + c\,\mathrm{T} = \$600$$

for the damage due to the freight and passengers.

The remaining sum of $600 is the destruction produced by the 12,000 miles run by the locomotive engines; whence we have

$$a = \frac{60{,}000}{12{,}000} = 5 \text{ cents};$$

or five cents for the injury done by the passage of the locomotive engine over every mile of the road.

We obtain, then, from this procedure, $a = 5$ cents; $b = 4$ mills; and $c = \frac{4}{5}$ mill, and for our formula

$$\frac{5N}{100} + \frac{4T}{1000} + \frac{4P}{5000}$$

If these values be correct they will apply to any other similar case.

The first iron used on the South Carolina road, was destroyed in less than six years—after it had borne about 130,000 through tons, and 120,000 through passengers, and the locomotive engines had made 10,000 through trips. The formula will give for this case,

$$\frac{10{,}000\times5}{100} + \frac{130{,}000\times4}{1000} + \frac{120{,}000\times\frac{4}{5}}{1000} = 81{,}116$$

for the destruction of the iron per mile. This is, no doubt, very near, the true value of the first iron used on that road, estimated at the present prices.

There are several other roads, of both descriptions, for which similar computations might be made, and which would confirm the estimate—and I shall take occasion, at a subsequent period, to present much data of the same character in a tabular form. But without discussing this branch of the subject further, at present, it may be stated in round numbers, that the average destruction of the half inch plate rail, caused by engines, freight, and passengers, is equal to about 8 *mills per ton net per mile;* and by comparing the above expression of the wear of the rail, with that previously obtained for the wear of the cars and engines, we will perceive that they possess very nearly the same value—or that the injury done to this iron, by the passage of a train, is but about 10 per cent. less than the wear and tear of the engine and cars composing the train.

In the application of this formula, however, the fact is not to be overlooked, that it is derived from the destruction of the plate rail, and is intended only to be applied to that description of road. *The destruction of any form of* T *or* H *rail, which I have yet seen, will be greater.* It is true that the expenses of maintenance for some new roads, provided with heavy iron, are yet very light, and they will possibly continue to be light until they have carried from three to five hundred thousand tons of freight —when, if the rail is still in existence, they will be very heavy.


It requires but little experience, and no speculation, to bring us to this conclusion. Let us take the two patterns, fig. 1, and fig. 2, for the purpose of illustration. Fig. 1, is a common form of edge rail, of 60 pounds per yard, of which the head, or upper table, A, weighs 20 pounds. Fig. 2, is a common plate rail, $2\frac{1}{2}$ inches wide, by $\frac{1}{7}$ of an inch thick, which also weighs about 20 pounds.

This flat bar is supported along its whole length and breadth by the

wooden string, S, and the edge rail is supported only in the centre by the vertical stem, P. Is there now any reason why the unsupported flanch, *f*, should do more service than the supported flat bar, B? The vertical stem and base of fig. 1 never wear out; it is the head of that rail which is crushed and rolled to pieces. When the rail is destroyed the lower portions are untouched; but when the head is bruised and split, the whole rail is rendered useless—and when the rail is ruined, 60 pounds of iron per yard, are lost to the company. The flat bar will bear just as much—indeed, being supported, a little more—hammering, and when it is destroyed, but twenty pounds are lost. Besides it may be welded when broken, the ends may be "upset," and restored when split; new holes, when necessary, may be punched, and it can be returned to the road until the lamination and splintering throughout render it wholly unfit for useful service.

But it is not my intention to speculate here on the relative merits of rails. The present object is to adduce facts and conclusions based on observation of many roads of various descriptions, in relation to the destruction of such rails as are ordinarily adopted. I know that my opinions on this head are not those of the public, nor of many professional gentlemen of much experience; but I believe they are, nevertheless, correct, and I therefore submit them to a test which will speedily be applied, and by which this question will be most conclusively settled.

The rails of the Reading road are, by common consent, acknowledged to be good; the pattern is considered, by the advocates of edge rails, to be unexceptionable; and the mode of manufacture adopted—that of making the lamina horizontal—is considered to render them almost proof against wear.

In regard to these rails—with all their merits, and all their superiority—I affirm,

1st. That they will not withstand the rolling of the trade of the Schuylkill for one year.

2nd. That before 800,000 tons of coal have passed down and the empty cars have been returned on them, the present track will be entirely unfit for safe usage.

3rd. That it will cost from 50 to 75 cents to replace the iron which is destroyed by each ton of coal that descends from Pottsville to Richmond, on the present track. And,

4th. That before next August, if the company succeed in obtaining the trade which they desire, this rail will be pronounced *too light* by the very parties who now think it will last forever.

The fault, however, is less in this particular rail than in *iron*, which is not tough enough for such usage, at such prices.

I know that the *Providence road* will be adduced as evidence against me, where the road has been some six years in use, and the iron is yet sound; but the Providence road actually passes but 30,000 tons per annum on a single track, and must yet stand 25 years before it can do one year's business of the Schuylkill canal.

The *Georgia road* may, perhaps, be quoted as evidence, where *experience*, they say, has demonstrated, beyond all question, the ability of railroads to compete with canals for the conveyance of heavy freight; but the Georgia road has been less than three years in operation, and has *not yet carried as much freight as has sometimes passed along the Schuylkill canal in three days!* Pour the trade of the Schuylkill, or Erie canal on parts of that road, with such engines as would be needed for its conveyance, and the track would be crushed in less than four weeks.

The *Boston and Lowell road* will be quoted. This road has not yet carried, in the eight years of its existence, an aggregate tonnage equal to the annual Schuylkill trade—and that tonnage has been sufficient for the destruction of the first track of edge rail, and the company are now, and have been for some time, using the second and third tracks.*

The *Camden and Amboy road* was originally provided with a "permanent" track. The aggregate trade has not yet reached 300,000 tons net—the reader who feels any interest in such matters can cross the Delaware to Camden, and examine the old rails, and form his own conclusions; he will then be able to judge whether these have given out because they are too weak, or because the material, in this form, is inadequate to a much greater effort.

In *England*, however, it is contended, people have more experience. The *best* experience there, is that of the Liverpool and Manchester railroad, a work which was opened to public use in the fall of 1830. This road was at first supplied with two tracks of edge rails, weighing 35 pounds per yard. The rail answered very well until the fall of 1833, when the work had passed about 300,000 tons on each track, at which period £150 were expended for *new rails*. In the next half year, before they had transported 350,000 tons, an aditional outlay of 3,000 pounds Sterling was required for new rails, and the adopted pattern was pronounced *too light* for the service. A rail weighing 50 pounds per yard was next tried, and subsequent experience showed that that also was *too light*. A new pattern was then projected, weighing 62 pounds per yard, and forthwith submitted to the same rough usage. The trade on this road is great, and soon tests the merit of fancy. This pattern was also found inadequate, and another, weighing 70 pounds per yard, was fixed upon, which was, *last year*, regarded as the pattern rail. I have not yet heard how it wears, but one year more will test its strength on that road, where there is really a heavy trade, although the net tonnage does not reach one-half, nor much exceed one-third of the average trade of the Schuylkill, or Erie canals. I do not believe that either pattern would resist the action of one year's business of one of those works, if it were confined to a single track.

I trust that those who have made observations on this interesting subject, will communicate them for publication in this Journal. If there be an edge

* It is proper to say that the rails of this road were taken up after six years' use, because they were too weak; but we never meet with rails that are strong enough after they have sustained the passage of 600,000 tons.

rail in the United States, which has sustained the passage of a million of tons of freight,* conveyed by locomotive engines, it could not but be regarded as a most encouraging circumstance, and its history ought to be known; such a rail—weighing 60 pounds per yard—would show the practicability of reducing the average cost of this item, for such rails, down to 6 mills per ton per mile; and, therefore, below any result which I have yet been able to obtain. My impression is, from the comparisons of the actual destruction which I have been able to make, that its value may be reduced, by the adoption of a suitable flat bar, and a moderate speed, to 3½, or 4, mills per ton per mile.

(To be continued.)

## NOTES ON PRACTICAL ENGINEERING.—NO. 3.

### *Railway Curves.*

There are two modes of running curves in general use here; by chords and by tangents. In Col. Long's manual, published many years since, the method of chords is adopted; in Mr. Van De Graaff's work a system of rectangular co-ordinate axes is used in connection with the method by chords; in Mr. Mifflin's treatise a geometrical process is adopted, the auxiliary curves being actually traced on the ground and the curve itself traced by the mode of chords; in Mr. Johnson's tables the system of tangents is adopted and the offsets to hundredths of a foot calculated for tangents of from 25 to 200 feet in length, increasing by 25 feet; the angles of deflection and lengths of arcs are also given for tangents of 100, 150 and 200 feet. The offsets are the parts of the secant included between the tangent and the curve, and the angles which they form with the tangents are also calculated. In the "Civil Engineer and Architect's Journal" of 1840 there are very extensive tables of ordinates from tangents from ¼ to 5 chains, calculated to the nearest tenth of a foot, but the deflections are not given as the chain alone is used.

Opinions differ as to the value of the different methods. Where the tangents are run out on the ground, a variety of curves may be laid off with great ease from the same tangents, and this is frequently desirable where the ground is so difficult as to require a pretty close approximation to the best line even for a preliminary survey. The following table is taken from the "Civil Engineer's Journal" and, as the use of the Transit is general here, the deflections for tangents of 500 feet have been calculated, so that in its present form it may be often useful to the American engineer.

*Table for setting out Curves by Ordinates from Tangents with the angles of Deflection for Tangents of* 500 *feet.*

| Radii in feet. | Tangents in feet. | | | | | | | | | | Angles of deflection |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 50 | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | |
| | | | | | | | | | | | ° ′ |
| 500 | 2·5 | 10·1 | 23·0 | 41·7 | 67·0 | 100·0 | 142·2 | 200·0 | 282·1 | 500·0 | 90 00 |
| 6 " | 2·1 | 8·4 | 19·1 | 34·3 | 54·6 | 80·4 | 112·7 | 152·8 | 203·1 | 268·4 | 79 37 |
| 7 " | 1·8 | 7·2 | 16·3 | 29·2 | 46·2 | 67·5 | 93·8 | 125·5 | 163·8 | 211·0 | 71 04 |
| 8 " | 1·6 | 6·3 | 14·2 | 25·4 | 40·1 | 58·4 | 80·6 | 107·2 | 138·6 | 175·4 | 64 00 |
| 9 " | 1·4 | 5·6 | 12·6 | 22·5 | 35·4 | 51·5 | 70·8 | 93·8 | 120·6 | 151·2 | 58 06 |
| 10 " | 1·2 | 5·0 | 11·3 | 20·2 | 31·8 | 46·1 | 63·3 | 83·5 | 107·0 | 134·0 | 53 08 |

* In a report on Heron's cast iron rails laid before the committee of Science and Art of the Franklin Institute, about two years ago, I stated that no road in the United States had yet sustained one million of tons of freight. I have not yet heard of such an instance.

| Radii in feet. | Tangents in feet. | | | | | | | | | | Angles of deflection |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 50 | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | ° |
| 1100 | 1·1 | 4·6 | 10·3 | 18·3 | 28·8 | 41·7 | 57·2 | 75·3 | 96·3 | 120·2 | 48 53 |
| 12 " | 1·0 | 4·2 | 9·5 | 16·8 | 26·3 | 38·1 | 52·2 | 68·6 | 87·6 | 109·1 | 45 14 |
| 13 " | 1·0 | 3·9 | 8·7 | 15·5 | 24·3 | 35·1 | 48·0 | 63·1 | 80·4 | 100·0 | 42 04 |
| 14 " | ·9 | 3·6 | 8·1 | 14·4 | 22·5 | 32·5 | 44·5 | 58·4 | 74·3 | 92·3 | 39 18 |
| 15 " | ·8 | 3·3 | 7·5 | 13·4 | 21·0 | 30·3 | 41·4 | 54·3 | 69·1 | 85·8 | 36 52 |
| 16 " | ·8 | 3·1 | 7·1 | 12·6 | 19·7 | 28·4 | 38·7 | 50·8 | 64·6 | 80·1 | 34 42 |
| 17 " | ·7 | 2·9 | 6·7 | 11·8 | 18·5 | 26·7 | 36·4 | 47·7 | 60·7 | 75·2 | 32 47 |
| 18 " | ·7 | 2·8 | 6·3 | 11·2 | 17·4 | 25·2 | 34·4 | 45·0 | 57·2 | 70·8 | 31 03 |
| 19 " | ·7 | 2·6 | 5·9 | 10·5 | 16·5 | 23·8 | 32·5 | 42·6 | 54·1 | 67·0 | 29 29 |
| 20 " | ·6 | 2·5 | 5·6 | 10·0 | 15·7 | 22·6 | 30·9 | 40·4 | 51·3 | 63·5 | 28 04 |
| 2100 | ·6 | 2·4 | 5·4 | 9·5 | 14·9 | 21·5 | 29·4 | 38·4 | 48·8 | 60·4 | 26 47 |
| 22 " | ·6 | 2·3 | 5·1 | 9·1 | 14·2 | 20·5 | 28·0 | 36·7 | 46·5 | 57·6 | 25 39 |
| 23 " | ·5 | 2·2 | 4·9 | 8·7 | 13·6 | 19·6 | 26·8 | 35·1 | 44·4 | 55·0 | 24 32 |
| 24 " | ·5 | 2·1 | 4·7 | 8·3 | 13·0 | 18·8 | 25·7 | 33·6 | 42·6 | 52·7 | 23 32 |
| 25 " | ·5 | 2·0 | 4·5 | 8·0 | 12·5 | 18·1 | 24·6 | 32·2 | 40·9 | 50·5 | 22 38 |
| 26 " | ·5 | 1·9 | 4·3 | 7·7 | 12·0 | 17·4 | 23·7 | 31·0 | 39·3 | 48·5 | 21 46 |
| 27 " | ·5 | 1·9 | 4·2 | 7·4 | 11·6 | 16·7 | 22·8 | 29·8 | 37·8 | 46·7 | 20 59 |
| 28 " | ·4 | 1·8 | 4·0 | 7·2 | 11·2 | 16·1 | 22·0 | 28·7 | 36·4 | 45·0 | 20 14 |
| 29 " | ·4 | 1·7 | 3·9 | 6·9 | 10·8 | 15·5 | 21·2 | 27·7 | 35·1 | 43·4 | 19 34 |
| 30 " | ·4 | 1·7 | 3·8 | 6·7 | 10·4 | 15·0 | 20·5 | 26·8 | 33·9 | 42·0 | 18 56 |
| 3100 | ·4 | 1·6 | 3·6 | 6·5 | 10·1 | 14·5 | 19·8 | 25·9 | 32·8 | 40·6 | 18 20 |
| 32 " | ·4 | 1·6 | 3·5 | 6·3 | 9·8 | 14·1 | 19·2 | 25·1 | 31·8 | 39·3 | 17 46 |
| 33 " | ·4 | 1·5 | 3·4 | 6·1 | 9·5 | 13·7 | 18·6 | 24·4 | 30·8 | 38·1 | 17 14 |
| 34 " | ·4 | 1·5 | 3·3 | 5·9 | 9·2 | 13·3 | 18·1 | 23·6 | 29·9 | 37·0 | 16 44 |
| 35 " | ·4 | 1·5 | 3·2 | 5·7 | 8·9 | 12·9 | 17·6 | 22·9 | 29·1 | 35·9 | 16 16 |
| 36 " | ·3 | 1·4 | 3·1 | 5·6 | 8·6 | 12·5 | 17·1 | 22·3 | 28·3 | 34·9 | 15 59 |
| 37 " | ·3 | 1·4 | 3·0 | 5·4 | 8·4 | 11·1 | 16·6 | 21·7 | 27·5 | 33·9 | 15 23 |
| 38 " | ·3 | 1·3 | 3·0 | 5·3 | 8·2 | 11·8 | 16·2 | 21·1 | 26·8 | 33·0 | 14 59 |
| 39 " | ·3 | 1·3 | 2·9 | 5·1 | 8·0 | 11·5 | 15·7 | 20·6 | 26·1 | 32·2 | 14 37 |
| 40 " | ·3 | 1·3 | 2·8 | 5·0 | 7·8 | 11·3 | 15·3 | 20·1 | 25·4 | 31·4 | 14 15 |
| 4100 | ·3 | 1·2 | 2·7 | 4·9 | 7·6 | 11·0 | 15·0 | 19·6 | 24·8 | 30·6 | 13 53 |
| 42 " | ·3 | 1·2 | 2·7 | 4·8 | 7·4 | 10·7 | 14·6 | 19·1 | 24·2 | 29·9 | 13 37 |
| 43 " | ·3 | 1·2 | 2·6 | 4·7 | 7·3 | 10·4 | 14·3 | 18·6 | 23·6 | 29·2 | 13 16 |
| 44 " | ·3 | 1·1 | 2·6 | 4·6 | 7·1 | 10·2 | 14·0 | 18·2 | 23·1 | 28·5 | 12 58 |
| 45 " | ·3 | 1·1 | 2·5 | 4·4 | 7·0 | 10·0 | 13·7 | 17·8 | 22·6 | 27·9 | 12 41 |
| 46 " | ·3 | 1·1 | 2·4 | 4·3 | 6·8 | 9·8 | 13·4 | 17·4 | 22·1 | 27·3 | 12 23 |
| 47 " | ·3 | 1·1 | 2·4 | 4·2 | 6·7 | 9·6 | 13·1 | 17·0 | 21·6 | 26·7 | 12 09 |
| 48 " | ·3 | 1·0 | 2·3 | 4·1 | 6·5 | 9·4 | 12·8 | 16·7 | 21·2 | 26·1 | 11 54 |
| 49 " | ·3 | 1·0 | 2·3 | 4·1 | 6·4 | 9·2 | 12·5 | 16·3 | 20·8 | 25·6 | 11 39 |
| 50 " | ·3 | 1·0 | 2·2 | 4·0 | 6·3 | 9·0 | 12·3 | 16·0 | 20·4 | 25·1 | 11 25 |
| 6500 | ·2 | ·9 | 2·0 | 3·6 | 5·7 | 8·2 | 11·1 | 14·6 | 18·5 | 22·8 | 10 23 |
| 60 " | ·2 | ·8 | 1·9 | 3·3 | 5·2 | 7·5 | 10·2 | 13·4 | 17·0 | 20·9 | 9 31 |
| 65 " | ·2 | ·8 | 1·7 | 3·1 | 4·8 | 6·9 | 9·4 | 12·3 | 15·5 | 19·3 | 8 47 |
| 70 " | ·2 | ·7 | 1·6 | 2·9 | 4·5 | 6·4 | 8·8 | 11·4 | 14·4 | 17·9 | 8 10 |
| 75 " | ·2 | ·7 | 1·5 | 2·7 | 4·2 | 6·0 | 8·2 | 10·7 | 13·4 | 16·7 | 7 37 |
| 80 " | ·2 | ·6 | 1·4 | 2·5 | 3·9 | 5·6 | 7·7 | 10·0 | 12·7 | 15·6 | 7 09 |

W. R. C.

THE ERIE CANAL—ITS CAPACITY—LOCKAGES—IRON BOATS.

We were among many who, in 1834–5, were deluded into the belief, after the completion of our present lateral canals, of the necessity of procuring enlarged avenues for the trade beyond our own State, at that period the capacities of railways to convey freight was not fully developed. We adopted and advocated the plan of a large, or "steamboat canal," 8 feet by 90 feet, from lake Ontario to the Hudson, with locks, 30 feet by 130 feet. The plan was to take advantage of the natural waters of the Oswego river, the Oneida river and lake, and from thence by Rome on the north side of the Mohawk river, to the Hudson. The length of this canal was 92 miles to Utica, and from thence to the Hudson 107 miles, total 199 miles of canal, showing a difference of canal, of 213 miles to be constructed, in favor of the Oswego route, compared with the Buffalo route. The natural waters of lake Ontario and Niagara river, 160 miles.

So feasible was the project, and limited the expense, from Oswego to Utica, owing to the use of the rivers Oswego and Oneida, and lake Oneida, 57 miles, the estimated cost was only $1,131,898, demonstrated by actual surveys. Five and a quarter millions were allowed as the cost of the canal to the Hudson Such was its feasibility, that the canal interest became alarmed for the diversion of the western trade by a cheaper channel, and in a reckless manner, rushed into the enlargement of the Erie canal, without regard to party or to its cost. It was truly a *sectional* movement, made without sufficient surveys and examinations, and we are disposed to exonerate the engineers for their estimates, as they candidly said in their report, they had not time to make the necessary surveys. Warnings of the difficulties, and statements, that the estimates were inadequate, were treated with derision. We well recollect being told by the chairman on canals, in 1835, "The policy of the State is decided on, we cannot entertain the subject of seperate canal from lake Ontario, and the use of the Welland canal, or, a ship canal around Niagara Falls, let their merits be what they may, we must enlarge the Erie canal." In consequence, a bill was introduced, *which passed without remark!!* giving the canal board full powers to make the canal of any size, pledging the whole treasures of the State to this stupendous undertaking. It was pointed out to the canal committee "that the tonnage of the upper lakes was than actually let down into the lake Ontario, by the Welland canal; that the vessels could be transferred from the lakes to the sea-board, by the improvement proposed, in the fall, to return with loads in the spring; that our fresh water sailors, instead of spending six months in idleness, could be transferred with their vessel to the sea-board, and have employment the entire year; that our lake vessels were particularly adapted, from their construction and light draught of water, to our West India and southern country trade; that 140 miles of canal navigation and tolls would be saved; further, that by the plan proposed we should have two canals, and competition instead of one, and this too for one-third the sum $27,000,000, we then stated (in face of the calculation of $12,400,000)

it would take to enlarge the Erie canal to Buffalo; that by the plan we proposed, we should avoid the interruptions and damages incident, as has proved to be the case of the enlargement; that, to a great extent, we should have to make a new canal in all the difficult places, to enable us to construct the locks, culverts, aqueducts, etc., in the summer."

The "bubble age" with the canal mania of the day has, however, passed, and the truth should be told. It is now well recollected, that both parties had to elect their candidate for the presidency. "The Young Lion of the West," and the majorities beyond Cayuga bridge were to be courted. The project of a separate large canal, from lake Ontario to the Hudson, being frustrated by timid politicians, without a fair arguing into its merits, led us to examine into the necessity and extravagance of making a ship canal out of the Erie canal for the trade of our own State, a canal that only required to be bottomed out, and double locks constructed to Syracuse, this side of the main lateral canals. We discovered this was everything that we wanted for the trade and commerce of our own State, and for the trade beyond us, the Oswego route could defy competition.

We opposed the enlargement from principle; we had not a dollar involved in the question. To ascertain the necessity of the enlargement, we were led to examine, in 1835, into the number of lockages at Alexander's lock, west of Schenectady—the test lock for the business on the canal. We found the average was only one every 12 minutes, during the season of navigation—that in this time the lockages could be trebled. To arrive at the nature of the trade on the canals, the present comptroller, Mr. A. C. Flagg had the goodness to adopt the suggestion, to class the tonnage floated on our canals, under the following heads:

The produce of the *forest*, of *agriculture*, of *manufactures*, of *merchandize*, and of other articles. The tables of 1836 compared with subsequent years, led to the discovery that the produce of the forest which in 1836 was 755,252 tons of the 1,310,807 the whole number of tons that floated on all our canals, fell off in 1842 to 504,597 tons, of the 1,236,031 tons that during that year floated on our canals. During this period, the increase of tonnage from agriculture, and from all other articles, did not make up the decrease of lumber, although the tolls were greatly increased, from the fact, that the tons produced from agriculture, paid four times the tolls paid on the produce of the forest.

The obstinacy with which the enlargement was persisted in, without adequate surveys and estimates, led us to expose the folly of the same. This occurred in 1836, 1837, particularly, after the extension of the Mohawk and Hudson railroad to Utica, and the construction of other railways in this country and Europe, began to develope the capacity of this, truly styled "*better improvement of the age*," to convey freight, as well as passengers at all seasons of the year; and this too, at rates to defy competition on this line by the Erie canal, if properly constructed and located.

We well recollect that such was the mania for canals, that we were laugh-

ed at for our folly in advocating such doctrines, and were considered by many who had not investigated the subject, as fit for a straight jacket. We well recollect stating six years ago, that the Erie canal was not up to one-third of its capacity. This deduction was drawn from the experience of the lockages at Alexander's lock, on the greatest days of business in 1835-6. We then stated "*that further expenditure beyond clearing out the present canal to four feet and making double locks and pond reaches to Syracuse was unnecessary.*" That such was the improvements then making in the paddle gates—and the case was instanced on the Lehigh canal of their passing a boat through a lift of 32 feet in 2½ minutes, while ours were only 8 feet—that from this fact, there could be no question of the capacity of the Erie canal, when improved as pointed out, and releived of its packet, and semi packet boats of emigrants and their baggage, that it would answer the wants of this State for all time to come. That if the western States were to be accommodated, as they should be, and the State to hold the toll gate, the Ontario route should be adopted, as the cheapest.

This conclusion was drawn from the fact, that our lockages in 1835 and 1841, the years of the greatest business did not exceed 12 minutes to a lockage, on an average. We stated, "that there would be no difficulty from past experience, in passing 55,000 or more lockages, instead of 25,998, the number passed in 1835." This number was reduced in 1842 to 22,869 with a continued falling off this year, so as not to exceed on an average, a boat, every sixteen minutes.

Holding these views, and in corroboration of the same, we were gratified to perceive in a late report of Mr. Little, the canal commissioner to the deputy comptroller, Mr. G. W. Newell, that on the 11th inst. at Fultonville, and under all the disadvantages of the cold weather, and as he states "considerable ice in the canal, and snow falling several inches," that 92 lockages were accomplished in 7 hours and 15 minutes being in the ratio of one for every 4¾ minutes for an 8 feet lift. This is not to be compared with the celerity of lockage on the Lehigh, and on other canals, although there is no doubt but that the ice and snow greatly impeded the operation, or it could have been done in less time.

The above ratio of 4¾ minutes, would give for the season 71,600 lockages, being more than three times the number of lockages this season, with a large increase of tolls, and capacity of the boats.

With facts of this kind, and yet another, that instead of the capacity of the canal, up to 1841 to float boats drawing 2 feet and 11 inches of water, with a load of only 30 to 40 tons, such is the improvement in the canal, by *bottoming it out* and in the construction of the boats and by the adoption of the iron boats, (which we advocated in your Journal for several years,) that we have now repeated instances of boats loading 60 to 83 tons, drawing three feet of water, the latter load being an iron boat, with Ericsson's propellers. We venture, therefore, little in predicting, that 80 tons to above it, when 3 feet 6 inches water can be obtained, will be the common load for the iron

coat, and further, that the distance from the Hudson to Buffalo, will be accomplished by steam, in one-third the time, now performed by horses, thus again trebling the capacity of the canal.

It should be taken into consideration, that our business has heretofore been performed by single locks. Now we have double locks to Utica, the most crowded part of the canal, and east of all the lateral canals.

We will close with the remark, often repeated, let the railways parallel to the Erie canal have the privilege to carry freight the entire year, even burthened with tolls, or like the New York and Erie railroad, be free to compete with the canal, and our word for it, we may suspend the enlargement for a long period, if not entirely, and save full $20,000,000 in its prosecution. This will certainly be the case if we include the interest that is lost ere the canal is used during its entire length.

J. E. B.

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For the American Railroad Journal and Mechanics' Magazine.

REMARKS ON MR. ELLET'S FORMULA FOR COST OF TRANSPORTATION ON RAILWAYS.

In your November number, there is an article under this caption, by Mr. Charles Ellet, Civil Engineer, who therein lays down certain *fixed laws*, which he further terms simple principles such as cannot well be doubted or denied. Against the validity of these laws we beg to offer some remarks, leaving it to your intelligent readers to decide between us.

1st. Mr. Ellet's law on motive power.

"The cost of motive power with engines of the same class is proportional to the distance which the engines run. The cost per mile is nearly the same on all roads of all grades, the difference in expense on roads with different grades consists not essentially in variations of the cost per mile run, but in variations of the number of miles which must be performed to do the same duty."

*Remarks.*—The reader should first have some idea of the several items composing the cost of motive power and the proportions which each item bears to the whole expense, which for an example we will state as follows:

| | | | |
|---|---|---|---|
| Wages of engineman and fireman, | per annum, | $1150 | 25 pr ct. |
| Fuel, | " | 2000 | 44 " |
| Oil, etc., | " | 350 | 7 " |
| Repairs of engine, | " | 1000 | 24 " |
| Total cost of running an engine doing full work, pr an., | | $4500 | |

Scarcely one of the above items can be called strictly constant, the wages even, which are the most so, will differ with the locality and degrees of skill of the men employed. The fuel, nearly half of the whole cost, is widely different; the price in Georgia is $1 per cord, and 3 and $4 per cord in the middle and northern States, and the *quantity used* depends on the velocity and amount of load, etc. The repairs of engines, these are affected by the quality of the machine itself, of the road it runs upon, the velocity and the skill and care of the driver. Scarcely any two roads are alike in the qual-

ity of their engines. Some are made to run 35,000 miles per annum, and others will hardly perform a third of that work; a fair average of annual work for one engine is from 18,000 to 20,000 miles which she will do at a cost per mile run, varying with the circumstances here enumerated; this variation being as much as 16 to 33 cents per mile or about 100 per cent. The comparative cost of transportation on railways will thus to some extent be affected by the difference in expense *per mile run*, but the real test of their *comparative economy* is at last determined by the *amount of business or load* which is found for every mile which must *necessarily* be run on the respective lines, the disproportion in the miles thus run and the loads carried therewith on different roads, being in general very considerable, whether of passengers or freight, but which, while the expense of running is constant, will be ever changing favorably with the progressive increase in business commonly attendant on the stimulus from railways, and is finally limited only by the power of the engines on the particular grades of the road, the facility of overcoming which, has been of late greatly increased, and thereby the economy of railways. We offer the following instances in exemplification of these positions: thus on the

| | Grades | Cost to run an engine per an. | Amt. of net load pr trip. | Total tons per annm. | Cost per ton. | Miles run. | Cost pr. mile run |
|---|---|---|---|---|---|---|---|
| Baltimore & Ohio, | 84 ft. | $4500 | 20 | 2500 | $1 80 | 20000 | 22½ c. |
| Georgia road, | 37 | 3300 | 40 | 5000 | 66 | 20000 | 16½ |
| Reading road, | level | 4000 | 160 | 18000 | 22 | 20000 | 20 |

The variations are here seen to be scarcely any in the cost of the miles run, but widely so in that of the *duty performed*, going to show that the want of *adequate and regular business* is the real root of all the evils of a railway, and as this business grows upon it, so does it improve in general consolidation and in profitableness. Every one of the roads cited above have improved in both these particulars *with age*, and particularly the first. The Reading road not yet fairly mounted, with as yet *but one foot* in the stirrup, is perhaps the only one using steam in this country, which in *freight* is so lucky as to be worked full up to the capacity of its machinery and grades, and to have both the one and the other of the most favorable kind for profitable transportation, the cost *per ton carried* and *per mile run* being here nearly one and the same, while on most other roads it is *widely* different and the waste immense. Being a practicable thing, we shall soon expect to see the further economy practised on the Reading road, of making the *tonnage carried* at least equal *if not greater* than the *miles run*, that is, an engine running 188 miles should be of the capacity to deliver at least 250 tons.

2d. Mr. Ellet's law on repairs of road.

"The repairs of road, with equal trade, are proportional to its length, that is, ceteris paribus it costs twice as much to keep up a road 200 miles long as it does to maintain one in the same condition of which the length is 100 miles; just as it costs twice as much to run engines 200,000 miles as it would to run the same class of engines 100,000 miles."

*Remarks.*—It is right to state that the repairs of road are proportionate to its length, that is a *mileage* charge; it consists of two items, the renewal of materials composing the road and the labor of making those renewals and in keeping the track level, the drains free and all other work about the *road bed*, both items will of course be very various on different roads; the one, in the *first cost* of the materials and their exposure to decay on the particular line of road; the other as it may have a firm foundation, easy drainage, freedom from deep cuts, etc. The experience, however, of now some 12 to 15 years applied to efficient roads adequately constructed, enables us to say that the several items of sills, bridges, iron, etc., may be entirely *renewed* by an appropriation of per mile per annum, $300

The important item of labor, the principal source of the after economy of railways, if liberally bestowed, may differ widely, but to do all the work generally required on a fully employed road an annual expenditure per mile will be necessary, of about 350

$650

per mile or $65,000 per annum for 100 miles, as the maximum for *this kind of road*, which will vibrate yearly, but not exceed that sum at its climacteric point of age, which is made up of the average duration of each of its materials, towards and from which point it will be ever either approaching or receding. The common error is to suppose that the *whole* first cost of a road is *again* to be incurred at the end of a certain time, without adverting to the fact that these annual appropriations or intermediate outlays had provided against this contingency, *as necessary*, to insure both safe and profitable transportation over it. That neglect occasionally occurs in this and other respects, as the result of poverty, is certainly true, but where this principle of always keeping the road and machinery up to the *standard of new*, is faithfully attended to, there can be no distinction of old and new roads as made by Mr. Ellet, except as we have already stated, the latter should be *all the better* for their years.

The illustration in the latter part of this law of Mr. Ellet's for road repairs, leads to the inference that they are in proportion to the business done on them; this is not entirely so, the item for renewal of materials may with the increase of business be slightly increased, but that for labor in upholding track, etc., should be nearly as good for 500,000 as for 100,000 tons; and its economy will tell favorably just as the business of a road is large or small; as in the Reading road in the year 1843, the estimate for maintenance and repairs of road is $45,000, which on its tonnage for this year of 250,000, will be 18 cents per ton, while in 1844 with the tonnage doubled, the same item at $50,000 per annum, will not exceed 10 cents per ton. The wear of most of the materials of a railway are now well ascertained, the iron or the principal one, being that about which there is most speculation, enough however is known to establish the fact when the article is good in quality and adequate in weight, that its duration is such, as to make its renewal compassable, after a deduction for the old iron, by a very small annu-

al appropriation; and we are assured that the iron founders derive but *little custom* in England from the annual wear of the iron rails, even there, where the velocity is seldom less than 30 miles with travel and 15 miles per hour with freight. The maximum for the latter in this country is now fixed at about 10 miles per hour. Railways, hardly yet out of the experimental stage, have been gradually working up, in their structure and machinery to the point of adequacy to the duty required of them—more than that would be waste—although the fault here had better be rather a little too much than too little. Till tately the road had to do everything for the locomotive, now there is a reciprocation of favors between them, and the latter can adapt itself to almost any strength of structure with increased power instead of losing any of it. This may well be termed a *compound stride*, in this new, useful and indispensable system of conveyance.

3d. Mr. Ellet's law for repairs of cars.

"The repairs of cars are proportionate to the number of tons conveyed and to the distance to which they are conveyed. It costs twice as much to repair cars which run two millions of miles as it does those which run one million of miles per annum. Again, it costs twice as much to repair cars which convey 20,000 tons as it does those which convey 10,000 tons a given distance. The same principle applies equally to the conveyance of passengers; it applies also to accidents, incidentals and contingencies, for these increase with and are proportional to the increase of business."

*Remarks.*—The repairs of a car whether passenger or freight, will of course be in some proportion to the work it does, that is, under equal circumstances and quality of article. Tha car itself and the treatment of a car is very different on one road and another, arising principally in the character of the road itself, if a flat bar or an edge railroad, its proper adjustment, and the use more or less of breaks as required by the undulations of the road, these twist a car and subject it oftener to jerks and concussions, and then the expense of attendance; on some roads the breaks may require one man to every three cars, on others one man to every twenty five; his wages of $300 per annum are in one case $100 per car, in the other only $12, this, however, has nothing to do with the repairs, but shows one of the expenses of heavy grades.

We find in England passenger cars doing full work are repaired at a cost of 5 to 6 per cent. per annum on their cost, and in this country with roads generally inferior, 6 to 8 per cent.; freight cars doing rougher work but at a less speed are renewed from 10 to 15 per cent. on the cost, against all casualties and giving them full employment. The reasonableness of this charge will appear when it is considered of what a car is composed and the value about it to be renewed. Let us take a Reading coal car, these at present cash cost of the items, have $120 of iron and $40 of wood on them, or $160 in all. Iron castings which formerly were 5 to 6 cents per lb. are now 2¼ cents per lb. from which the old material at 1 cent per lb. would remain to be deducted; the wooden portion of this kind of car is now turned

out very cheaply by machinery. Here, then, is but a trifling value of the most perishable part of it to replace. Say this car delivers 300 tons per annum, which at 8 cents per ton, the estimate of the superintendant of the Reading road for repairs, is $24 per annum, or just 15 per cent. on the value, and this is to include all casualties as the damage from *mere running over the road* is scarcely an appreciable item. A double track now in preparation by this road will result in much economy on this item, and it is accordingly expected to be reduced on that event and other developments in management, which come only with time and experience. That accidents are necessarily proportional to the increase of business on roads is not in accordance with either the practice of this country or England, a large business always affording the more means and increasing the skill, for their avoidance.

These remarks in their specific application, will, we trust, for the sake of railways present and to come, do something towards overturning these laws of Mr. Ellet, but in order the more fully to do this, we here give his "formula," of which these laws are the basis, and compare it with the actual results on the Baltimore and Ohio railway, as given with much distinctness of detail in their recent report for 1843, a feature much to be commended and which we like to see practised in future by all railways of any note, seeing the good that it has done the cause in this instance.

FORMULA.

| | For new roads under 4 years old. | For old roads over 4 years old. |
|---|---|---|
| For repairs of road, for every mile of road, | $300 pr mile. | $500 pr mile. |
| For every ton conveyed one mile, | 9 mills | 14 mills |
| For every passenger carried one mile, | 7 " | 7 " |
| For evey mile travelled by the engines, | 24 cents. | 27½ cents. |

RESULT ON THE BALTIMORE AND OHIO RAILWAY IN 1843.

The report gives 509,000 miles as travelled by the engines at a cost of, $95,936

The formula for old roads is 27½ cents per mile, 137,430—41,494

or a variance from actual practice of 43 per cent. on this item.

The report states the freight trains to have carried a tonnage equal to 7,034,310 tons carried one mile for, (or 4 mills per ton,) $28,381

The formula gives a mean cost for old roads of 14 mills, 98,480—70,099

or a variance from actual practice of 240 per cent. on this item.

The report states the repairs and maintenance of road for 178 miles, at per annum $100,000

The formula gives a mean for old roads of $500 pr mile, 89,000—11,000

or a variance from actual practice of 12 per cent. on this item.

What annihilation is here, in this "formula" of itself, to the railway system, but lest this should not be enough, he has a "corps de reserve" in freshets, tornadoes, and incendiaries, under the name of "extraordinary expenses" not included in the formula, which, according to him, will finish what

the "formula" may have spared. But Mr. Ellet has deceived himself by the confidence he has so innocently placed in railway reports which are in general notorious for their indistinctness of detail and otherwise inconclusive character for any such purpose as *just* comparisons. In this way he has been led into the mistake of calculating against the *well established rule* with railways, that their expenses are in an inverse ratio to their business—that is, the latter being large, the former will be comparatively small. Moreover, and finally, laws of this character to be good for anything should be uniform and invariable; the railway therefore, if these properties belong to Mr. Ellet's laws, should be *stationary*, instead of which, it has been and still is *most progressive* in the character of both its own structure and its appurtenant machinery, as evinced in the recent and last improvement by Baldwin and Whitney, in the locomotive, so truly termed the *main spring* of this system, and by which the light flat bar road has been saved from condemnation. The most of our railways have been sickly only from insufficient business, and it would be unfortunate indeed, could Mr. Ellet establish that *full work* the panacea to which they look confidently for recovery will be their certain death; a fate which all good men should deprecate, in the case of works so beneficial in their effects. F.

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For the American Railroad Journal and Mechanics' Magazine.

## NOTE TO ARTICLE ON "CANALS OF CANADA."

(See Railroad Journal for November, 1842.)

Important events which have occurred during the last year, require notice, in order fully to comprehend the "prospects" of these canals on so gigantic a scale. Their failure was based on the absence of that general information and high character which are to the projection what mechanical skill is to the execution of a work. The latter is necessary to the assistant—to the engineer who aspires to success both are indispensable. The earth work and masonry of canals are well understood by the American engineers and their Canadian assistants under whose superintendance these canals are placed; and it can scarcely be doubted, that they will be respectably executed. But no excellence of workmanship can compensate for radical defects in the projection.

It was observed (page 258,) that

"That portion of the western trade which seeks a foreign market via the St. Lawrence, is attracted by political rather than natural or engineering advantages, and, to this extent, does not come within the province of this Journal."

Still it may be observed that the present Canadian and British duties are 4*s.* per quarter of wheat or 12 cents per bushel, in place of the old sliding scale of from 1 to 5*s.* per quarter, which had averaged 2*s.* or 6 cents per bushel. The western trade has been very heavy this year, but the trade of the St. Lawrence has not increased. This is owing more to the losses under the old system than to the slightly increased disadvantages of the new tariff.

The locks of the Welland canal have been increased to 150 feet in length, the better to accommodate the "propellers," a class of vessels the writer ventured to predict, (Journal, April, 1842,) could scarcely fail to come into gen-

eral use. This was done principally on account of the representations of forwarders from Oswego, who have derived much and will derive still greater benefit from the Welland canal. Indeed this work may be considered rather American than Canadian, and this feature will gradually increase, rendering the canal ultimately able to support itself.

Speaking of the down trabe it was said, (page 259,)

"The down trade is by the river, about 200 miles, barges and small steamers running direct from Kingston to Montreal. The draft of water is limited by the depth of the "Cedars," where, at lowest water, a vessel cannot pass, drawing more than 4 feet, to 4 feet 2 inches. It must be observed that nothing has ever been done to improve the down trade of the St. Lawrence, and, the writer believes, that a sum not exceeding £20,000 cy. would give 5 feet water at lowest water in the Cedars, besides less important improvements, such as removing boulders, placing buoys, etc., at other places."

During the last summer, a new and deep channel has been discovered in these rapids. This is a most important and remarkable discovery, leaving little to be desired as far as the down trade is concerned. The almost certainty of the existence of such a channel was pointed out to the writer in September 1842, by Mr. McPherson Jur., a member of the principal forwarding house in the Province—while descending the "Cedars" in the steamer "Juno," Capt. Marshall, who was the first to show its practicability. Had this been achieved by the Board of Works it would have been considered, and not without reason, as entitling them to the lasting gratitude of the country; the press would have been unable sufficiently to commend their merits, and even the thinking few, who see the inevitable result, would have been forced to confess, that this happy discovery would do much towards compensating the immense and permanent injury inflicted by the Board on the Province.

It can scarcely be considered an exaggeration to say, that this channel has been found in spite of the Board who had utterly neglected and in fact discouraged every attempt to aid the improvement of the rapids. Thus, so late as 10th Oct. 1842 it was pronounced by he chairman of the Board, Mr. H. H. Killaly, as "a dangerous navigation requiring the expensive protection of insurance," though this was only three-eighths of one per cent. or not quite 2 cents per barrel of flour from Kingston to Montreal through the *old* channel of the Cedars where losses were principally sustained. Yet this trifling charge was more than sufficient to cover the risk even *then*, and Messrs. McPherson, Crane & Co. were their own insurers.

As remarked in the article to which this *note* refers, "the down trade is indeed the only *great* consideration;" yet was the chairman of the Board an "engineer of great experience and scientific acquirements," ignorant of the risk attending the downward navigation of the St. Lawrence which is of course accurately measured by the rates of insurance based on the experience of many years. This element is indispensable in projecting a canal which is to supersede the use of the river for down freight. The very first point which would have arrested the attention of an engineer acquainted with the western trade and not "a stranger to the country" is, obviously the downward navigation of the St. Lawrence; yet the forwarders of Canada,

unlike their more fortunate brethren of Oswego, failed in drawing the attention of the Board to their representations of the vast benefits which a very slight expenditure might effect in the navigation of the rapids, more especially in the "cedars." The Board appear to have entirely overlooked "the part of Hamlet," till the new channel at last made even *them* understand that the down trade must go by the river. It is scarcely necessary to observe that this had been long known to every one else at all acquainted with the trade and navigation of the St. Lawrence.

The enlargement of the Lachine canal, the locks of which are now 20 by 100, will give the "coup de grace" to the only successful canal the Province has owned or will own till the Welland canal shall clear expenses and interest; a period many years distant. Upwards of 60 tons have been repeatedly carried on the Erie canal, less than 4 feet deep, with wooden boats. An iron steamer took 83 tons of freight from Albany to Oswego passing through locks 15 by 90. Boats filling locks 100 by 20 and drawing 6 feet water will be about equal to boats filling the locks of the enlarged Erie canal will which are 100 by 18, though they are decidedly superior in proportions to the latter. Since the "Cedars" no longer limit the draft these boats can always descend the St. Lawrence, and the present facilities of the down trade by the river—without any cost beyond part of the trifling amount of insurance—are more than equal to the utmost advantages anticipated from the enlargement of the Erie canal, to be executed—if ever—at an enormous cost and not to be attended with any *reduction* of tolls, though inflicting a direct tax on the State of $600,000 per annum.

The St. Lawrence canals depend therefore on the up freight and this was at last admitted by the chairman of the Board in parliament. Now the absolute amount and rate of increase of the western trade are well known, and the probability of the small portion of that trade, going via the St. Lawrence, increasing to an amount sufficient to pay the interest on four millions of dollars from the tolls on 36 miles of canals, besides repairs and superintendance, is too remote to have any interest for the present generation.

Judging from the dilatory proceedings of the Board in completing the Chambly and Cornwall canals (as far as canals in that climate may be considered to be completed without protection wall on the inner slopes) the writer does not believe they could in any circumstances fulfil their promises as to time; judging from the actual cost of works in Canada he does not believe the Province has the means of completing these short canals; and judging from this determination to enlarge the Lachine canal he does not believe the Province will, at the end of ten years, be able to point to a single successful work. In the case of the Lachine canal they are literally carrying out the views of Dean Swift's philosopher, whose highest ambition it was to confer on his country a race of sheep without any wool.

The expenditure of large sums in different parts of the Province necessarily gives a certain degree of popularity to the Board, and the promises which are made as to the early completion of the St. Lawrence canals plea-

se those who believe they will increase the trade of the country. It is therefore the time when the views of the writer are least likely to find favor in Canada; consequently the period the most honorable to bring them forward. They remain as given a year since in this Journal.

It would be difficult to find a more brilliant proof of the immeasurable superiority of private enterprise over governmental attempts. The latter with immense expenditures accomplish nothing useful and will be remembered only by the taxes imposed to pay the debt—the former present freely to the public a vast benefit, which their own common sense had led them to suppose attainable, and which their own skill, energy and resources had triumphantly demonstrated to be so.

*New York, Nov.*, 1843. W. R. CASEY.

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For the American Railroad Journal and Mechanics' Magazine.

## CROTON WATER PIPES BURSTING.

Since the previous article was written, (see number for October) I have tried a series of experiments on the subject; being desirous to arrive at a just conclusion, which results were as follows.

When the faucet was as large as the pipe to which it was attached and full open at the discharge, there was no pressure at the end of the faucet acting to burst the pipe, except the friction of the water in its passage; this shows that if the pipe is burst (which it is) by suddenly shutting off the water alone.

I also tried in my series of experiments on this subject, shutting off the current of water at about 40 feet from the end of the pipe, which end was the discharge, this produced about the result or jar in the pipe beyond the faucet, though by a different mode, as if shut off in the ordinary way with a pipe 40 feet long, this pipe I tried both straight and with a number of bends, or serpentine in form, the straight pipe had but one jar or "blow," on shutting off the water, but the bent or serpentine form had as many jars or "blows" in the pipe as there were bends; these were caused in this way, the impetus of the water in the straight pipe, beyond the cock was in motion after the faucet was shut, which still proceeded as long as the impetus so given lasted, forming a vacuum between the stop-cock and the end of the water in the pipe, which returned with a "blow" which was the "water hammer," whose operation was the same as explained in the before mentioned article; when the pipe was bent the blow or jar was less heavy on each part, but amounting to the same in the aggregate, the blow nearest the cock was the heaviest, and they decreased gradually at each bend or turn according to length of each junction, towards the end of the pipe, all striking successively on the return of the water.

Glass pipes have been proposed and tried in Europe for conducting water but have not been applied here, to the writer's knowledge; from some experiments on glass I am of the opinion, that from it being almost non-elastic it could not be applied where stopping the water would jar or strike it, as it

breaks very easy under such circumstances, but will stand an enormous dead pressure.

Glass varies much in its strength under different circumstances, as the least change by heat or cold *unequally* applied will weaken it much and if extended sufficiently will break it. It is true iron is affected in the same way, after repeated, unequal, very high heating, and then cooling, as we see by gas retorts, stoves, etc., after use.

History relates an invention by which glass was made that could not be broken; this cost the inventor his life, by being thrown off the scaffold from which his glass was dashed but did not break; we want such glass for Croton water pipes.

Many a man's invention in these times, costs him *his life*, or *its equivalent, his all.* You will hear from me again on some other subject soon.

*New York, Nov.*, 1843. CIVIL ENGINEER.

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ACCIDENTS UPON RAILROADS.

*Messrs. Editors.*—The reader was made acquainted in our last number with the regulations in *England* excluding cattle from railroads, and with the safety to which those regulations had contributed. How long are we to wait for the adoption of similar regulations here, where they are more needed, the mischief being more imminent? The triumphs of human genius over the elements are daily advancing the march of civilization, and adding to the comforts of the human race; and though it might be presumptuous to doubt that the power of steam has been given to us for ultimate good, it may well be questioned whether the public authorities are warranted in sending forth an agent of such tremendous effect without adequate safeguards. The application of this new power on water and on land is the great invention of the age.

Railroads, and the speed of which they are susceptible, have become as indispensable to all classes of our population as any of the old modes of locomotion, and the convenience and interests of the public will neither admit of abandoning the one nor reducing the other. Therefore, if from collisions arising from obstructions upon the road, these improvements are not only to lose much of their utility, but be made eminently dangerous in their operations, it becomes the duty of the legislature to take the subject into its hands, and, following the lights of experience, apply the same remedies here that have been found both indispensable and effectual elsewhere.

That degree of safety which by possibility can be attained by the most judicious management upon the part of railroad companies, and by the utmost care and caution of their agents, ought to be first insured; but if experience prove these inadequate, the obligation to provide further safeguards becomes not less imperative. To accomplish the first there certainly has been no want of rigor in those who make the laws. Towards the railroad companies and their agents the penal code of Maryland is marked by the utmost severity. Although the operations of their roads yield little or no profit, railroad companies are required to spare no expense in keeping their works in thorough repair; to provide the best and most approved system of machinery, and adopt every proper improvement which the effort of genius may suggest, even under the heavy exactions of their inventors, and to employ the fullest complement of agents of competent skill; and from all persons in any way engaged in the operations of the works the utmost care and

caution which the highest capacity can insure is rigorously enforced. Not only so; but here, in this State, the wise, humane rule of the common law, which presumes innocence until guilt be proved—the great shield interposed by justice against wrong and oppression—is completely inverted. In the case of injury to person or property, arising from an accident on a railroad in Maryland, the law directs the civil magistrate to take it for granted, without any proof whatever, that the casualty happened from the fault of the company or its agents! To presume that an engineman has carelessly thrown the sparks from his engine into a neighboring barn, or heedlessly, and at the risk of his own safety, run his engine into an animal on the track, and to punish him accordingly—unless, by some other testimony than his own, which from the nature of the case is seldom at hand—he should be able to prove that the accident was unavoidable. We think the reader will not only pronounce this to be in all conscience enough, but will be apt to consider it an inversion of all the rules of deduction from evidence, by which we usually form a judgment of human conduct. In my view it would require only a small spice of injustice or prejudice in the magistrate who is called to execute the law, to assimilate it to the iron rule of the despot of Prussia, which doomed a soldier to be shot, if, while on parade, his hat should be blown off by the wind.

Let it be conceded, however, that this degree of severity is, under the circumstances, necessary, and therefore justifiable. Why is it necessary and justifiable? Surely the public authorities do not mean to treat those who have, at a heavy expenditure of capital, introduced these new works and adapted them to the wants of the public, as guilty of improper conduct, and therefore objects of vindictive justice! In sanctioning their enterprizes, the legislature sent them forth as the projectors of beneficial improvements, themselves the objects of the countenance and protection of the law. Bound, no doubt, to exert their utmost care to prevent injury to others from the dangers incident to their enterprize; but entitled, in common with the public, to be guarded against hazards, produced by the wantonness or carelessness of others, which no care of theirs could avoid.

It is to be supposed that the legislature is under no obligation to afford the public other security against accidents on railroads than the imposition of penalties upon those managing them? To say to the survivors, in case of death, or to the man who may have lost his limbs or his property, look for remuneration to the railroad company? Money, severe as the penalty may be upon the company, does not always afford adequate remuneration for such injuries; it seldom mends a limb; it never restores life; and in the majority of cases can make no atonement whatever for its loss. What the public want, and what the nature of the case demands, is *preventive* measures; those which *preserve* persons and property from injury, rather than such as leave them exposed to loss, and attempt, after it is suffered, to make compensation for it.

On no other ground can the penalties, already adverted to, against the railroad companies and their agents be excused, and much less justified. They are designed, and in this respect entitled to commendation, to exert the force of the penal power to insure the utmost care and skill and providence upon the part of the companies to guard against mischief, and thereby afford all the security which in this way can be given—nothing more. The grievances, or omission, or whatever else it may be called, as we think, is, that the legislature seem to have proceeded upon the idea that the railroad travelling was exposed to no other risks or danger than those which might arise from the negligence of the companies or their agents, or that these could ac-

complish impossibilities; and have thereby left the most ordinary source of danger unguarded. Let the case be supposed, that an animal, emerging from its concealment by the side of the road, suddenly comes upon the track, within ten yards of the locomotive, attached to a train of four or five cars, containing more than one hundred passengers, and proceeding at the rate of twenty or fifteen miles per hour; at twenty miles, the engine would run the ten yards in a single *second* and at fifteen *in a second and a quarter!* In a second and a quarter of time, it would be manifestly impossible to let off the steam, reverse the engine, and apply the breaks—much more to stop the train! The collision takes place and limbs are broken or lives lost. Under such circumstances, if any one should be unreasonable enough to bring suit the magistrate who might be selected to examine the case, whoever he might be, if not grossly corrupt, would find himself compelled to exonerate the railroad company and the agents. If he did otherwise, he would afford no security against the recurrence of a similar casualty. Now, then, here is a danger, and one of almost daily occurrence, against which neither the company nor the public have any security whatever. It may be observed, moreover, that in the case supposed, the result would not have been different, as it respects the collision, if the animal had been *fifty* instead of *ten* yards in front of the engine.

Now, if there be only a single class of obstructions, and that of frequent occurrence, which it is impossible for the railroad agents by any care on their part to avoid, against that the public have the right to demand the requisite protection. We have been able to conceive of no other likely to be effectual than an explicit law making it the duty of all to *clear the track.*

But there are more than one class of obstructions equally perilous, to which we may refer in another number.—*Balt. American.* T.

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*Messrs. Editors.*—We have already spoken of the speed of railroad travelling, and of its importance to the public. In the further investigation of the subject, however, we think that this part of it ought at no time to be lost sight of. In truth, the capacity to transport the greatest weights, at the least cost and highest velocity, constitutes the chief object of the improvement. It is this which has enabled it to supersede at once the ordinary modes of conveyance—has impressed its influence upon the present age, and is destined to produce even more wonderful effects in the future. While on the water, the power of steam has diminished the size of our rivers, and contracted the ocean itself to less than half its breadth, the same agent on the land has leveled the loftiest mountains, and gone far to annihilate those distances which previously separated the various parts of our continent. In this country the effects, social, moral and political, are not to be overrated. While most of the other nations of the globe are reaping the benefits of the centralization resulting from the power of steam on water and on land, we could not if we would, creep along at the old fashioned pace; but when we come to contemplate the consequences of bringing all parts of this vast empire within a few day's journey, and of uniting their population in one great family, we will be apt to desire rather to augment than diminish the power of the locomotive.

Now, the cheap transportation of the greatest weights at the utmost attainable velocity, is to be produced, under the lights of science and the guidance of experience, by the power itself; but that degree of safety which is to give the grand result, must be looked for to the interposition of the lawmakers; and we repeat that the measures adopted for this purpose should have reference to the nature of the improvement, and to the character of the risks. They should be applied with enlarged views and bold hands. If

we mean to master the elements and render them subservient to our daily wants, we must do it effectually—we must suffer no stale usages, or unreasonable privileges to stand in our way, or weaken our dominion.

Bearing these considerations in mind, let us pursue the tenor of our remarks. It appears, by the report of Mr. Stevenson, that in 1838 the average speed of railroad travelling in *England* was thirty miles an hour; which, in the communications attached to the appendix to the report of the Irish railway commissioners, was regarded as a mere *starting point.* Able commentators upon that report confidently anticipate, from improvements in the railway and machinery, a speed of from 60 to 100 miles an hour, and of such rate predicate the ultimate advantages to be expected from the introduction of railroads. In the same year, as appears from the same report, upon railroads in the United States, at that time comprehending a distance of 1600 miles, the average speed was stated at fifteen miles an hour. Since that period the extent of railways in the United States has not only been considerably increased, amounting at present to not less than 3,000 miles, but we have acquired the means of a greatly accelerated velocity. In numerous instances, too, they have been adopted as post roads, and it may be safely assumed, from this cause, that the competition among railroads, that upon all the principal lines, and especially those employed in the transportation of the mail, the average speed is not less than twenty miles per hour; and to attain that aggregate velocity upon a long line of road, the train upon many parts of it must proceed at a still greater speed. In the reports to the English parliament, to which we have already more than once referred, it is estimated that at a speed of thirty miles an hour, a train cannot be stopped in less than two hundred yards; and in our first paper we ventured to assert that in this country, at a speed of twenty miles, a train could not be stopped in less distance than one hundred and fifty yards. Whether we are right or wrong the reader may, with a slight examination, entirely satisfy himself.

An engine and train, at the rate of twenty miles an hour, may be stated to run six hundred yards in a minute, ten yards in a second, and one hundred and fifty yards in fifteen seconds, or one quarter of a minute. To stop a train it is required not only to shut off the steam, but to reverse the motion of the engine, and apply the breaks of the cars; and for these purposes, ten seconds may be stated as the least possible time. But during these ten seconds the engine will have run one hundred yards, according to all experience, a heavy train at the rate of twenty miles an hour, under circumstances the most favorable to resistance, will continue its motion, though doubtless somewhat reduced, for at least ten second more. If its velocity should be reduced one half, it would require the whole space we have supposed.

It is to be observed, moreover, that the space in which a train may be stopped, is dependant not only upon the weight and speed of the train, but the grade of the road, and often varies from one-eighth to a quarter of a mile. We have been present at an experiment made under the most favorable circumstances, with a train not exceeding the usual weight, and proceeding at a speed of less than twenty miles an hour; and we saw it very clearly demonstrated that with the readiest application of the appliances, such a train could not be stopped in less than one hundred and fifty yards. If the fact be at all doubtful, the legislature have it in their power—and in a case of so much importance it is surely their duty—to ascertain its truths. In the mean time we will proceed upon the hypothesis now proved.

It is clear, then, that if obstructions be found upon the track of a railway at a less distance than one hundred and fifty yards from the engine, no degree of care nor skill nor power upon the part of those in charge of the train

can, by possibility, prevent a collision. When the reader reflects upon the frequent occurrence of obstructions from cattle on the road within even a less distance, he cannot fail to require that some further security should be provided against the consequences to which they too surely lead.

We profess to be somewhat familiar with the operations of railroads. Our attention has been often drawn to the subject, and we have sought information in regard to it from all sources within our reach. We have, too, frequently had occasion to examine particularly into the circumstances attending casualties of almost daily occurrence; not only to detect, and if found, to punish negligence, but to discover any possible means by which a recurrence of the evil could be avoided.

Of the numerous accidents arising from cattle found upon the track, we are not aware of a single instance in which the collision has happened when it was possible to discover the animal within one hundred and fifty yards of the train. On those roads with which we are more particularly acquainted, we may state positively that no such instance has occurred. Indeed, it may be affirmed, that such collisions most frequently occur where the obstruction is found within a distance varying from ten to fifty yards than at any other; and in all the cases that have come under our observation the persons in charge of the train have freely risked their own lives to prevent harm to those exposed in the cars. Although the public on such occasions are apt to think only of the safety of the passengers, overlooking the fatal injuries often inflicted upon the humblest parties, we confess we have come, after much observation, to give a wider range to our sympathies; and to include within them those agents hourly, and in case of collision, inevitably exposed to disasters, which in a moment, may reduce their families to want. We have come to regard the conductors, and enginemen, and firemen of the trains as we do the adventurous sailor, who exposes himself in all weathers and risks his life upon the frailest spar or the slenderest rope to preserve the comfort and safety of the inmates of the ship; and we think that in legislating upon this subject, no humane statesman would overlook the protection justly due to such men. Now, as far as our experience goes, collision with cattle found upon the tracks of railroads may be said invariably to arise in one of the following cases:

1. Where the animal is found at night lying between the rails, and, in most instances, not discovered until actually entangled in the train.

2. Where the animal suddenly comes upon the track at night, or in the day time, from the bushes on the side of the road, and within a short distance from the locomotive.

3. Where, being on the track, but hidden from the view of the engineman by a curvature in the road, cannot be seen at a sufficient distance to enable him to avoid the collision.

These risks, it will be seen, afford ample room and space for fearful injury to life and limb, *against which, the law, as it now stands, makes not the slightest provision.*

In another paper we may refer more particularly to the most serious accidents which have arisen under one or all of the heads above stated.—*Baltimore American.* T.

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ADVANTAGES OF THE FORM OF RAIL AND STRUCTURE OF THE PHILADELPHIA AND POTTSVILLE RAILROAD.

In designing the parts of a new work, it is the duty of a skilful engineer to study the peculiar circumstances of the case, and proceeding from known laws and well ascertained facts to produce such a plan as can with certainty

be predicted to answer the desired end. In most cases, the trial of direct experiment, under all the given circumstances, is quite out of the question, particularly when *time* enters as an element into the calculation. All that can be done therefore is to make use of such experiments, or rather, of such experience as shall approach nearest to the case in point. In applying these principles to construction in general, and in particular to railroad construction, it is evident that there must be wide room for the display of that sort of discretion which mainly contributes to the formation of professional skill. When time has confirmed the predictions of the engineer, the case may fairly be quoted as experience in future works—and the careful examination this experience of works constructed upon our own soil, and therefore adapted to our peculiar wants, will in course of time form the most valuable part of professional information. It is therefore the duty of every one to present either the result of his own labors, or his observation on those of others, to contribute to the common stock of knowledge.

A period of four years having elapsed since the completion of the Philadelphia and Reading railroad, with a heavy traffic for the greater part of that time, we feel enabled to speak with some confidence as to the merits of the mode of structure employed upon that work. No description in our own words could be more full or accurate than that given by Messrs. Knight and Latrobe, in their celebrated report on the forms of rail and superstructure in the United States. This description, it will be seen, was written before the completion of the work; we have however allowed the first paragraph to stand, as identifying the time, and as showing that it contains no after thoughts.

PHILADELPHIA AND READING RAILROAD.

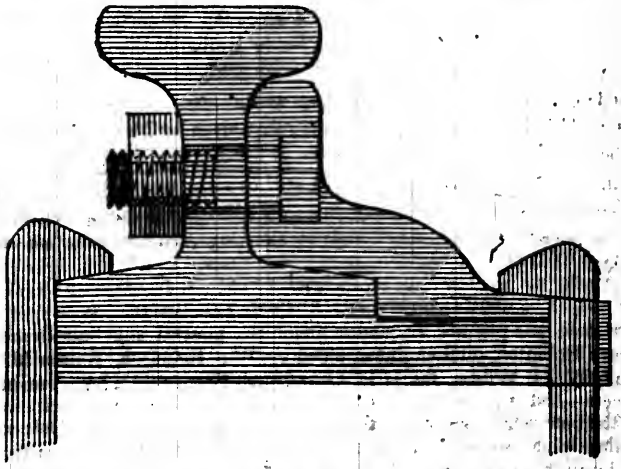
This road was planned by, and is under the general superintendence of Moncure Robinson, civil engineer, aided by Wirt Robinson, Wilson M. C. Fairfax, W. H. Wilson, James H. Grant, and Thomas P. Huger, assistant engineers—and is not yet completed. It is intended principally for the transit of the anthracite coal of the Schuylkill to market, upon the Delaware, at Philadelphia, and will extend from the coal region down the valley of the Schuylkill, at grades varying from a level to descents of 19 feet per mile in a direction from the mines, with the exception of the pass from the Schuylkill to the Delaware, where an ascending line from the former river to the summit of the divide, of 40 to 50 feet to the mile, will be admitted, upon which assistant locomotive power will be employed.

*Plan of construction.*—The H rail is employed, weighing 45½ lbs. per yard lineal; each bar is 18¾ feet in length, with square ends, and weighs, on an average, 282 lbs., or 8 bars to the ton. With exception of the square ends, the form of the rail resembles that on the Washington branch of the Baltimore and Ohio railroad, except that is 5⅛ lbs. to the yard heavier than the latter.

The rail is laid upon the white oak sleepers, or cross ties, 7 feet in length and hewn upon the upper and lower sides, so as to have a flat surface for the under bearing, and a similar one for the rail to rest upon of 8 inches wide; the depth of the sleeper being 7 inches uniformly. These are laid 3 feet 1½ inches apart from centre to centre, and cost, upon an average, delivered

at distances apart of about two miles, on the graded surface of the road, about 60 cents each. Timber is scarce and dear upon the Schuylkill, and it was said that these were brought by the Union canal from Huntingdon county. Each sleeper is laid upon a prism of broken stone, deposited in a trench 14 inches deep, 12 inches wide, and 9 feet long, transversely of the line of the track. The cost of broken stone was, on an average, (for this the first track) $1 10 per perch of 25 cubic feet, delivered in heaps 10 feet apart on the road surface. Two sizes of broken stone are used, the one to pass through a two inch, the other through a three inch ring, the larger of which constitute the lower portion of the mass. The stone were placed and compacted in three different layers, one upon the other. The spaces between the sleepers are filled with clay, or any material most convenient to be obtained. This filling reaches to the top surface of the sleepers in the middle of the track.

Every sleeper, (except where there is a chair,) is notched to a depth of about one-fourth of an inch, to receive the lower web of the rails. These notches cost 5 cents per sleeper, which is not included in the 60 cents above mentioned.



Of the *fastenings*, it may be observed, that the rails, at their joinings, rest upon cast iron chairs, let into the sleepers by means of notches cut for that purpose. The chair is 6 inches square at its lower surface, where it is five-eighths of an inch in thickness. Upon that side of the chair situated upon the outer side of the track, and upon the entire length of the chair, there is a portion of the casting having an upward projection, and passing over the lower web of the rail upon that side, and thence to the stem of the rail; and also extending to, or very nearly to, a contact with the under side of the *upper* web. Through this upper projecting part of the chair, there are two square countersunk holes, to receive square bolts, with heads formed to fill the countersunk holes: each bolt passes through one of these holes in the chair horizontally, and likewise through a hole in the stem of the rail, near its end. The hole in the rail, however, is not precisely square, as it is in the chair, but is $\frac{7}{8}$ by $\frac{7}{8}$ of an inch, and situated at a clear distance of $\frac{1}{4}$ of an inch from the end of the rail. The hole in the chair is for a bolt $\frac{7}{8}$ square,

and the head of the bolt to fill the countersink, is $\frac{1}{16}$ square. Upon the inner side of the rails, a nut screws upon each bolt, to hold the ends of the two rails to the chair, and in proper line, while the hole in the rail is wider than the bolt to allow for contraction and expansion from change of temperature. The bolt and nut weigh 7 ounces, and the chair 10½ lbs., and is held in place by means of 4 spikes, the heads of which pass over the edge of the chair, while their stems are driven into the sleepers, and also fill recesses left for that purpose in the corners of the chairs in casting them. The same kind and size of spike is used to fasten the rail to each sleeper, (except where the chairs are) the head of the spike passing over the edge of the lower web on each side of the rail. The spikes are 6 inches in length, and their stems are $\frac{3}{4}$ by $\frac{1}{2}$ of an inch, and they weigh about $\frac{3}{4}$ of a lb. each. It is thought that the stem should be square, and the length $4\frac{1}{2}$, or at most 5 inches.

The varied cost of the iron rails at Philadelphia, averaged about $60 per ton. And the cost of the conveyance to the road, by means of the Schuylkill navigation, was $2 60 per ton.

There are in the mile of track,

| | | | |
|---|---|---|---|
| Bars of rails, in number | 563, | weighing | 71 tons. |
| Chairs, | do. 563, | do. | 5,910 lbs. |
| Spikes, | do. 7,882, | do. | 4,524 " |
| Screw bolts & nuts, | do. 1,126, | do. | 481 " |
| Sleepers of wood, | do. 1,689. | | |

It was stated by W. M. C. Fairfax, (from whom most of these details were received,) that the track cost an average rate of $1 50 per sleeper, or $2,533 per mile, exclusive of the cost of all the iron materials, at Philadelphia.

The cost *of laying down* this single track of railway, consisting of excavating the trenches to receive the broken stone—putting down the broken stone—laying, notching, and adjusting the sleepers—putting on the chairs and the iron rails complete—*has been, on an average,* 40 *cents per sleeper*, or $675 60 per mile of track: to which W. M. C. Fairfax would add, for contingencies, such as cutting the iron bars, in order to make the joinings of each two have a position opposite to the middle of the length of the opposite rail, or bar, (this being a condition uniformly observed in the track) extra transportation, cleaning the side ditches, making crossings, etc., say about $200 per mile.

The above mentioned 40 cents per sleeper, or $675 60 per mile, is included in the aforesaid $1 50 per sleeper, or $2,533 per mile. The contracts for laying down the railway were made at so much per sleeper, viz., 40 cents, as above.

The entire cost of the single track, as laid, is stated by Moncure Robinson to be $7,617 per mile, inclusive of materials and workmanship.

We have omitted the cut of the chair and rail in plan and profile, as the minute accuracy of the above description will answer a much better purpose. The peculiarities of this system of construction are, the disuse of longitudinal timbers of any kind, the mode of fastening the rails in the chairs, and for allowing at the same time for changes in temperature.

The advantages attendant upon the longitudinal connection of the rails alone are, the saving of timber, at the time the road was built, a scarce article upon the Schuylkill; the broken stone or timber when partially decayed, with longitudinal bearers, will afford the means of passing water from a great distance so as to accumulate in such quantities as to prove dangerous

to the soundness of the road. Moreover, one more perishable article is stricken from the component parts of the road. The mode of fastening the rails from personal inspection, we have satisfied ourselves to be excellent—the allowance for temperature being perfect, while no displacement of the rail can possibly take place. After all that can be urged in favor of the form of this rail, the best evidence of its merit is the fact that it answers the purpose for which it was intended. There are other forms which doubtless would prove equally serviceable—but this has been tried and already found excellent.

It is the duty of all who are familiar with the *superiority* or *inferiority* of any form of structure to make known their remarks upon it for the benefit of others.

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By a singular mistake, our notice of Mr. Nott's advertisement was not inserted in the last number of the Journal. It will be seen that he aims mainly at private business, a source, in our opinion, sadly underrated, and as his experience and standing are unquestionable, we are happy to find him aiding the cause of the profession in the most efficient manner possible; that is, extending its usefulness by enlarging its field of operations.

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### IRON CANAL BOATS.

It was more than four years ago, and prior to any heavy expenditure on the enlargement of the Erie canal, that our correspondent, J. E. B., proposed the employment of iron boats on the canal. He urged on our canal board, as well as our forwarders, to build one, and to test their capacity. He argued, very naturally, that the same results would be found here, as had been experienced in England.

It is gratifying to find by the following extracts from the Miners' Journal, and from a late number of the Albany Argus, (making remarks on the "navigation of the Erie canal,") that this subject is at last claiming the consideration it merits. From inquiries made in this city, we have no doubt but iron boats, that will out last three wooden boats, can be constructed for $1600. Some of our best lake boats cost nearly this sum. The wooden boat is more subject to leake, and cause damage, arising from stones and obstructions that fall into the canals, than the iron boat. The latter are made perfectly water tight.

*Iron Canal Boat.*—The Miners', Pa., Journal contains a statement of the size, weight, cost, etc., of the new iron canal boat recently built at Pottsville. The light weight of the boat is 15 tons 12 cwt.; the weight of the boat and cargo was 85 tons 2 cwt., leaving a cargo of 69¼ tons of coal. The boat draws 4 feet ½ inch midships, and 4 feet 1 inch at the stern—say 4 feet 1 inch draught of water. The cost of the boat is stated at about $2200. In future, iron boats can be constructed for about $1800.

From present indications there is also every probability that for the first time, next season, *iron canal boats* will be extensively introduced on the Erie canal, and as they can as easily carry 85 tons of freight as wooden ones can 70 tons, this also must have no inconsiderable influence in increasing the present *capacity* of the canal.—*Albany Argus.*

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